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EVALUATION OF THE POINT LEAMINGTON DEPOSIT

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by

K.G. Stowe
Program Manager, Mineral Processing
Noranda Research Centre
240 Hymus Boulevard
Pointe Claire, Québec

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SUMMARY

The metallurgical response of one high grade and two low grade samples from the Point Leamington deposit have been studied under a contract from the Department of Supply and Services. Two series of flotation tests were conducted to optimize flotation response. Drill core, crushed feed samples and sized products from the flotation tests were studied with an electron microprobe and automated image analyzer to determine the mineral associations and the degree of liberation.

Point Leamington ore was found to be extremely fine grained massive sulphides with pyrite being the predominant mineral. The majority of the sphalerite and chalcopyrite were present as grains smaller than 10 microns. Fine grinding to over 90% -400 mesh and regrinding were required for satisfactory results.

Copper metallurgy was poor for all three samples with only 50% recovery achieved at a concentrate grade of 20% copper. Copper losses were mainly as very fine inclusions in pyrite. The chance for significant improvements in copper metallurgy appear remote.

Sphalerite mineralization is somewhat coarser than chalcopyrite. For the high grade sample, 85% zinc recovery was obtained in a concentrate analyzing 54% zinc. Results for the two low grade samples were considerably inferior at 60% recovery and 50% concentrate grade.

Gold and silver recoveries to the copper concentrate were 10% or lower for the three samples. Gold bearing minerals were not identified. Silver was detected at low levels (a few hundred ppm) in pyrite, arsenopyrite, chalcopyrite and sphalerite.

The economic prospects for the Point Leamington deposit are very poor unless additional substantial tonnages of high grade zinc ore can be delineated.

The results of the present study are in excellent agreement with previous work conducted by Noranda in 1971-75.

1. INTRODUCTION

In December 1985, the Department of Supply and Services (DSS) issued a request for proposals for an in-depth metallurgical evaluation of new drill core samples from the Point Leamington copper-zinc massive sulphide deposit in north central Newfoundland. The objective of the study was to produce marketable concentrates by conventional processing schemes. The ore was known to be very fine grained requiring extensive grinding for liberation. As part of the study, qualitative mineralogical studies were expected to be performed to characterize the ore and to determine mineral liberations.

The Noranda Research Centre submitted a proposal in January 1986. The Research and Productivity Council of New Brunswick (RPC) was identified as the sub-contractor for the required mineralogical studies. After several revisions, the Noranda Research proposal (Appendix 1) was accepted by DSS and a contract was issued on 15 September 1986. Total contract value was $159,815. The study was to run for 15 months, with a completion date of 15 December 1987. On 4 December 1987 a contract extension until 29 February 1988 was requested and received.

The contract proposal was broken down into five tasks:

TASK 1 Megascopic, Microscopic and Chemical Characteristics of the Ore

TASK 2 Preliminary Bench Tests and Mineralogy of Products

TASK 3 Extensive Batch Tests (and Mineralogy of Products)

TASK 4 Preliminary Economic Assessment

TASK 5 Reporting and Presentation

At a project review meeting at CANMET on 29 June 1987, the Task 3 requirements were modified to increase emphasis on the high grade zinc portion of the orebody. As well, additional high gold samples collected by Noranda Exploration were to be sent to RPC for gold and silver characterization.

To fulfill the requirements of their subcontract, RPC issued five reports during the course of the study. These reports are available under separate cover. They are:

TASK 1 — (i) *General Mineralogy of the Point Leamington Massive Sulphide Deposit*, RPC #MDP/86/11, 10 March 1987; (ii) *Quantitative Mineralogical Data for the Point Leamington Massive Sulphide Deposit*, RPC #MDP/87/02, 27 May 1987.

TASK 2 — *Quantitative Mineralogical Evaluation of Material from the Preliminary Bench Tests of Ore from the Point Leamington Massive Sulphide Deposit*, RPC #MDP87/06, 18 August 1987.

TASK 3 — *Detailed Mineralogical Evaluation of Products from the Extensive Bench Tests of Ore from the Point Leamington Massive Sulphide Deposit*, RPC #MDP/87/17, 5 February 1988.

OVERALL — *Final Report on the Mineralogical Study of Ore and Test Products from the Point Leamington Massive Sulphide Deposit*, RPC #MDP/87/27, 1 February 1988.

The important findings and conclusions from the above reports are integrated in the discussions that follow.

2. PREVIOUS METALLURGICAL TESTWORK

Extensive flotation testing of various Point Leamington samples was carried out by Noranda at both the Horne Division and Brunswick Mining during the period 1971-75. At Brunswick, a sample analyzing 0.6% Cu, 3.9% Zn, 0.9 opt Ag and 0.053 opt Au was tested([1]). Various flotation schemes were looked at, such as soda ash-SO_2-aeration, high lime with and without aeration, stage grinding, bulk flotation and a variety of collectors. The most selective copper flotation was achieved with lime. Optimum grind was found to be over 80% -400 mesh. A locked cycle test was conducted with the results in Table 1.

Since gold and silver recoveries were very low, cyanidation of the tailings was attempted. Direct cyanidation resulted in a poor gold extraction of 4.7%. Roasting of the tailings for 16 hours at 1200°F followed by cyanidation increased gold extraction to 87% (18% silver).

A parallel test program was conducted at the Horne Division. Metallurgical results based on tests on several different ore samples were optimistically predicted to be:

Copper - 15% concentrate grade at <75% recovery
Zinc - 50% concentrate grade at 75% recovery

A microscopic study found arsenopyrite to be fairly common (locally up to 20%) and that there was a definite relationship between anomalously high gold values and the presence of abundant arsenopyrite(2). However, some sections high in arsenopyrite were not necessarily high in gold, suggesting an inconsistent occurence. No visible gold was found. The poor copper recoveries were attributed to an abundance of 800 mesh chalcopyrite inclusions in pyrite.

A few unsuccessful attempts were made to separate a high grade arsenopyrite concentrate from a bulk pyrite-arsenopyrite concentrate. Sodium sulphide and potassium permanganate were used to depress arsenopyrite. Although the highest grade arsenopyrite product analyzed only 2.2% arsenic, there was some upgrading of gold apparent.

3. ORE SAMPLES

Just under two tons of ore grade material were collected under a separate DSS contract *Evaluation of the Point Leamington Deposit - Phase I.* Sixty-one boxes of unsplit drillcore arrived at the Noranda Research Centre on 8 October 1986.

The core was from four drillholes (L-1 to L-4) and was classified into three types for metallurgical testing - upper low grade (UPPER), lower low grade (LOWER) and zinc rich (HIGH Zn). The HIGH Zn ore was also expected to be high in gold. However, this material was only intersected in hole L-1.

J. Stirling and J. Melluish of RPC inspected the core and selected representative samples for mineralogical studies to characterize the ore (TASK 1).

The drillcore was classified into eight ore sections. The eight sections were crushed and prepared separately as shown in Figure 1. After preparation, all samples were placed in cold storage to minimize oxidation. A two kilogram sample of -4 mesh feed material from each section was forwarded to RPC for detailed chemical analysis and mineralogical study. Table 2 lists the weights and detailed assays of the sections.

After discussion with the scientific authority, it was decided to mix the four UPPER sections and three LOWER sections. Head assays of the economically important metals in the three composites (based on the average head assays from the flotation test program) are given in Table 3.

4. CHARACTERIZATION OF POINT LEAMINGTON ORE (TASK 1)

(from RPC reports MDP/86/11 and MDP/87/02)

4.1 Method

4.1.1 Core Samples

Forty-seven samples of drillcore were collected on 16 October 1986 (Table 4). Forty-six polished sections of the most interesting portions of these samples were prepared. In addition, seven polished thin sections were prepared in order to better examine the non-metallic gangue minerals.

Each section was examined using an optical microscope and JEOL 733 electron microprobe. Detailed observations were taken optically and either confirmed or improved upon using backscattered electron imaging and qualitative chemical analyses with the electron microprobe. Quantitative chemical analysis of sphalerite in typical textures was also done using the microprobe. Photographs (backscattered electron images from microprobe) of typical and/or interesting textures were taken.

4.1.2 Crushed Ore Sections

Two kilograms of crushed (-4 mesh) material from the eight ore sections was forwarded to RPC. At RPC, the samples were further crushed to -18 mesh (1.0 mm) and the -25 mesh material removed. The -18 +25 mesh fractions were mounted and polished. Grains of this size were considered large enough to exhibit basic textures while small enough to allow good representation in a single polished mount.

The samples were examined optically and eleven general texture types (Table 5) defined according to the types and quantities (visual estimates only) of minerals present. In each sample, 100 grains were classified according to these definitions and the distribution calculated assuming each grain to be the same size volumetrically. Any unusual features observed were also noted.

The JEOL 733 electron mircoprobe, in conjunction with a KONTRON automated image analyzer, was used to collect mineral distribution data based on the total measured surface areas of the different phases - pyrite, sphalerite, chalcopyrite, pyrrhotite and various trace minerals such as galena, arsenopyrite and cassiterite. The data were normalized to aid in sample comparison.

Phase size distribution data were also collected using the electron microprobe and automated image analyzer. Due to the intergrown nature of the phases, normal grain size data was felt to be misleading. For example, a *grain* such as the one in Figure 2 would be measured as one particle because the microprobe cannot discern grain boundaries. The cross-sectional size (normal grain size) would be calculated as the square root of its total surface area as measured by the image analyzer. This would be misleading as the particle is not a single circular grain of sphalerite but a series of irregularly intergrown grains which would probably break apart along grain boundaries as well as along the phase boundary. In this case, measurements of the various cross-sectional sizes (three are indicated by solid lines in Figure 1) were considered to be more useful in indicating both the finely intergrown nature of the ore and the probable grinds required for processing. The chord function within the image analyzer's programming was used to measure the length of chords intersecting the phase of interest along a horizontal projection. In each frame examined *chord*

length measurements were normalized.

4.2 Results

4.2.1 Core Samples

General visual estimates of the mineral distributions within the three ore zones are summarized in Table 6.

The UPPER and LOWER zones were found to be very similar. They are both composed primarily of pyrite exhibiting framboidal, granular to euhedral and massive textures and silicate/carbonate gangue (quartz along with small amounts of siderite, calcite and wollastonite). The other sulphide minerals are present generally as fine intergrowths with pyrite. Sulphides usually comprise 60 to 80% of the material (55 to 75% pyrite) although local concentrations of up to 98% were observed.

Sphalerite and arsenopyrite are much more common in the HIGH Zn zone. The silicate/carbonate gangue has a similar composition to the two low grade zones except for the presence of small amounts of apatite. Although chalcopyrite and sphalerite again occur as fine intergrowths, sphalerite also frequently is found in concentrated massives with up to 15% inclusions of other minerals.

Table 7 lists important features of the three ore zones. (For a more detailed review, refer to RPC report MDP 86/11.) The intimate mineral association and extremely fine grained nature of the Point Leamington ore are constant themes which have a significant effect on processing and metallurgical performance.

Numerous sphalerite occurences within the three zones were analyzed for zinc, sulphur and iron using the electron microprobe. The results are summarized in Table 8. The average iron content was just under 5% for the UPPER and LOWER zones and just over 6% for the HIGH Zn zone. The range of iron contents was approximately 3.5 to 8.5% with the highest readings for massive sphalerite (with inclusions) in the HIGH Zn zone.

4.2.2 Crushed Ore Sections

4.2.2.1 Distribution of Textural Types

Results of the optical examination and classification of 100 grams from the eight ore sections into the eleven general texture types (as defined in Table 5) are presented in Table 9.

The distribution of textures in the UPPER zone was quite consistent. Pyrite predominated, exhibiting disseminated to framboidal or granular to euhedral textures in the ratio of approximately 5:1 (Texture Types 1 and 2). Colloform textures also occured, although infrequently. Inclusions and intergrowths of sphalerite, chalcopyrite, pyrrhotite, arsenopyrite, and cassiterite comprised from <1 to 15% of the pyrite. The sphalerite often contained micro-inclusions of chalcopyrite. Ore composed of pyrite with 15-50% intergrown sphalerite (Type 3) was found in only approximately 1-3% of the grains. Framboidal to disseminated pyrite and arsenopyrite material (Type 7) comprised only 1-2%. In drillholes L-2 and L-4, the remaining material was basically sulphide-free silicates and carbonates (Type 9) - probably vein and perhaps dyke material. Drillhole L-1 contained approximately 4% sphalerite with up to 50% inclusions and intergrowths (Types 5 and 6). All the other phases present in the zone were found as inclusions in this sphalerite although pyrite, chalcopyrite, and quartz were most common. Drillhole L-3 contained 1% massive pyrrhotite with minor inclusions of chalcopyrite (Type 8).

The distribution of textures in the LOWER zone was not as consistent as in the UPPER. Pyrite was predominantly disseminated to framboidal with varying amounts of brecciated, granular and massive (Texture Types 1 and 2). However, significant amounts (14-25%) of the pyrite exhibited other textures with variation from drillhole to drillhole. Hole L-1 contained 18% sphalerite and sphalerite/pyrite-rich material (Types 4, 5, 6 and 3, respectively), whereas L-2 contained 11% and L-3 only 4%. Small amounts of framboidal to disseminated arsenopyrite and pyrite (Type 7) were found in L-1 and L-2. L-3 contained 9% massive pyrrhotite with chalcopyrite inclusions. Although sulphide-free silicate and carbonate material was found in all three holes, L-2 contained significantly more (10% compared to 1%).

The distribution of textures in the HIGH Zn zone differed significantly from that in the two low grade zones. Types 1 and 2 (pyrite) comprised only 43%. An additional 43% was found to be sphalerite (25%) and sphalerite/pyrite-rich (18%) materials (Types 4, 5, 6, 11 and 3). This material included a texture unique to the HIGH Zn zone - a mosaic of intergrown sphalerite, pyrite, chalcopyrite, pyrrhotite, gangue and sometimes arsenopyrite, galena and cassiterite (Type 11 - 7%). Another unique texture (Type 10), medium grained hollow atoll arsenopyrite with *cloud* arsenopyrite usually present, represented 4% of the material. Framboidal pyrite/arsenopyrite and sulphide free material (Types 7 and 9) were found in amounts similar to the other two zones.

4.2.2.2 Distribution of Phases

The distribution of phases (based on surface area measured) using the electron microprobe and automated image analyzer are given in Table 10. Arsenopyrite, galena and cassiterite were measured as one phase in all but the HIGH Zn zone. Arsenopyrite was found to be much more common and coarser in this zone and its distribution and size possibly of importance in subsequent processing.

As expected from the previous study of texture types, the mineral distribution in the UPPER zone was more consistent than the LOWER. The major components were pyrite and silicates/carbonates with only minor amounts of the other sulphides and cassiterite. Other features worth noting in the UPPER and LOWER zones are:

UPPER L-4 high pyrrhotite compared to other sections
L-1 relatively high sphalerite/chalcopyrite content

LOWER L-1 sphalerite/chalcopyrite relatively high
L-3 substantial amount (8.7%) pyrrhotite

L-3 sphalerite content higher than for L-2, which is in disagreement with general textural determination.

The mineral distribution in the HIGH Zn zone, as predicted by the textural distribution, was very different from the two low grade zones. Although pyrite

and silicates/carbonates were still the most common phases, sphalerite was much more abundant. Arsenopyrite and pyrrhotite were also unusually abundant. The chalcopyrite content was found to be low.

4.2.2.3 Size Distribution of the Phases

Quantitative size distribution data was collected in conjunction with the phase distribution data. The results are presented in Tables 11 to 13. The data have been normalized and galena, arsenopyrite grouped into one category except for the HIGH Zn zone. In most cases, the pyrrhotite and/or galena/arsenopyrite/cassiterite did not occur in large enough quantities to give a smooth distribution curve. Nonetheless, the general size range of the minerals can be ascertained.

K80 and K90 values (chord sizes below which 80% and 90% of chord lengths fall) for sphalerite and chalcopyrite are also given in Tables 11 to 13. The average values for the three zones were found to be:

UPPER sphalerite 6.1 microns, chalcopyrite 5.2 microns

LOWER sphalerite 7.6 microns, chalcopyrite 4.9 microns

HIGH Zn sphalerite 22 microns, chalcopyrite 6.8 microns

The extremely fine texture of the mineralization, especially for chalcopyrite, is readily apparent. Obviously, extremely fine grinding will be required for adequate liberation to be achieved. The sphalerite in the HIGH Zn zone is much coarser than in the other two zones. This, combined with its much higher sphalerite content, points to the potential for much better zinc metallurgy for this zone.

5. PRELIMINARY BENCH TESTS

5.1 Method

Batch grinding was conducted in either of two stainless steel rod mills - a

smaller mill for 1 kilogram feed charges and regrinding, and a larger mill for 2 kilograms of material. Primary grinding was conducted at 65% solids.

All flotation stages were conducted in Denver D-1 and D-2 laboratory flotation machines with the appropriate cell depending on the amount of feed material. All aeration and conditioning stages were also conducted in the Denver flotation machines.

Table 14 lists details of the various reagents used during the test program. Details of the test procedures and assay results for the preliminary bench tests are given in Appendix 2. Analyses were conducted either at the Noranda Research Centre (by atomic absorption) or at Lakefield Research of Canada Ltd. (especially for gold by fire assay).

A total of 25 batch flotation tests were conducted during the preliminary bench testing program. Important features of these tests are summarized in Table 15. The last eight tests, three on each of the UPPER and LOWER zones and two on the HIGH Zn zone, were performed to produce samples for mineralogical study by RPC at grinds ranging from 60 to 80% -400 mesh. The procedure for these tests is shown in Figure 3. Selected concentrates and tailings were cyclosized at Lakefield Research and forwarded to RPC for mineralogical evaluation.

5.2 Results

The grindabilities of the three composites were found to be quite different. Despite comparable feed size distributions (Table 16), vastly different fineness of grind were obtained at identical grinding times (Figure 4). The UPPER zone composite was found to be about 15% harder than the HIGH Zn zone (based on grinding time required to obtain 65% -400 mesh). Similarly, the LOWER composite was approximately 35% harder than the HIGH Zn sample.

Inferior copper metallurgy was obtained at all the conditions used. Copper losses to the flotation tailings (pyrite) were considerable even at grinds of 80% -400 mesh and when pulling a low grade copper rougher concentrate (strong flotation conditions). The flotation rate of the LOWER composite was somewhat slower than for the other two zones with higher collector dosages being required

to obtain similar recoveries. As shown in Figure 5, the grade-recovery curves in the copper rougher circuit for the three ores were fairly similar in shape.

Lime (pH 10) was found to give more effective pyrite depression in the copper circuit than soda ash-sulphur dioxide. However, copper recoveries were also lower with lime. A typical comparison is given in Figure 6.

Zinc contamination of the copper circuit was not a major problem. Zinc content of the copper rougher concentrate was generally close to the overall head grade which is typical of base metal ores. No zinc depressants or flotation conditions were tested which affected the zinc distribution in the copper circuit and it was felt that most of this sphalerite was unliberated.

As discovered previously in 1971-75, gold and silver recoveries were found to be very poor in both the copper and zinc circuits. Table 17 lists standard results for each ore type with low grade rougher concentrates.

For the LOWER and UPPER zones, zinc recoveries in the zinc circuit were relatively low, even at low rougher concentrate grades. Zinc losses in the tailings were generally about 1% for the LOWER zone and over 0.5% for the UPPER zone resulting in recoveries of only 60-70% (at about 20% Zn rougher concentrate grade).

Metallurgical results showed only a small improvement as the grind was increased from 60-80% -400 mesh. Metal losses in the tailings (pyrite) were generally slightly lower at the finer grinds. However, the difference was not pronounced.

Eleven products (concentrates and tailings) were cyclosized and the size fractions analyzed (Table 18). Detailed results can be found in Appendix 3. The size analyses confirmed the fine grained nature of the ore as generally the concentrate grades increased markedly at the finer sizes while tailings losses were much higher in the coarser fractions. Typical results for a copper concentrate, zinc concentrate and tailings are shown in Tables 19 to 21.

6. QUANTITATIVE MINERALOGICAL EVALUATION OF PRELIMINARY TEST PRODUCTS (from RPC report MDP/87/06)

6.1 Method

Polished grain mounts were prepared for seventy-seven cyclosizer size fractions from a number of preliminary flotation test products (Table 18 and Appendix 3). All the samples were examined optically. Twenty-three (Table 22) were chosen for further examination with the JEOL 733 electron microprobe interfaced with the KONTRON automated image analyzer. Mineral distribution, grain size and sphalerite liberation data were collected for all of these samples and additional data on particular polished sections as listed below:

(a) Copper Cleaner Concentrates
- liberation of chalcopyrite
- chalcopyrite association with or content of sphalerite

(b) Zinc Cleaner Concentrates
- sphalerite association with or content of pyrite

(c) Tailings
- liberation of chalcopyrite

The liberation of chalcopyrite in the zinc cleaner concentrates was not determined because the chalcopyrite was present in very small amounts as basically locked material. Pyrite/pyrrhotite, galena/arsenopyrite/cassiterite and silicates/carbonates were treated as single phases for the mineral distribution and grain size measurements. All results were based on total surface area measurements (area %) and not the number of grains (counts/frequency).

6.2 Results

The liberation of chalcopyrite and sphalerite in the twenty three size fractions studied is shown in Table 23. Table 24 presents an evaluation of the degree of intergrowth or inclusion of chalcopyrite and sphalerite in the other minerals

(mainly pyrite and silicate gangue) - fine, medium, coarse or liberated.

The chalcopyrite content of the various copper cleaner concentrate size fractions was low at 3-20% reflecting the strong flotation conditions used to maximize recoveries. Chalcopyrite liberation in these samples was only 20-50% with generally greater liberation at the finer sizes. The unliberated chalcopyrite was fairly evenly distributed as fine to coarse intergrowths or inclusions although the proportion of fine intergrowths increased in the coarser fractions. Considerable regrinding would be indicated to achieve a saleable copper concentrate grade. There was relatively little difference between the three ore zones.

Chalcopyrite losses to the tailings were almost exclusively (90% plus) as fine intergrowths, even in the +10 micron size fraction, thus confirming the results of the mineralogical study of the crushed ore sections. Little liberated chalcopyrite was lost (<1%). Extremely fine grinding (much less than 10 micron) would be required to significantly improve copper recovery.

As had been previously determined, the sphalerite mineralization was found to be somewhat coarser than the chalcopyrite. Sphalerite recovered in the zinc concentrates was present mainly as liberated or coarsely intergrown particles. Fine intergrowths and inclusions were relatively rare (<5%) giving promise of saleable zinc concentrates without the need for excessive regrinding.

Unliberated sphalerite in the copper concentrates was distributed evenly as fine to coarse intergrowths once again pointing out the need for fine regrinding in the copper circuit.

Similar to chalcopyrite, sphalerite losses in the tailings were predominantly (80%) as fine intergrowths and inclusions. Some potential for increasing zinc recovery at finer grinds was indicated, especially for the HIGH Zn zone where the percentage of fine inclusions in the +10 micron fraction dropped to below 60%.

In summary, it was found that considerably finer primary grinding was required to improve metal recoveries. Copper concentrate grade and copper recoveries

would remain the major processing problem. Saleable zinc concentrates were obtainable with a relatively small amount of regrinding.

7. EXTENSIVE BENCH TESTS

7.1 Method

Based on the results of the preliminary batch tests, the mineralogical evaluation of test products by RPC and a project review meeting with the scientific authority, increased emphasis was placed on the HIGH Zn zone as it was felt to be the only one with any hope of being economic to mine and process.

A series of 20 tests, including ten locked cycle tests (4 cycles each) was conducted. Locked cycle testing was felt to be very important due to the large amount of locked middlings material. A brief description of the tests is given in Table 25. Detailed procedures and results are presented in Appendix 4. All of these tests were conducted with two kilogram ore charges. The main parameter investigated was primary grind, although a few additional tests comparing lime and soda ash-sulphur dioxide were also completed. A single locked cycle test was carried out on each of the UPPER and LOWER zones. A standard flowsheet arrangement (Figure 7) was used for all of the locked cycle tests with variation of the reagent dosages depending on the ore zone and operating conditions.

Selected concentrates and tailings from four locked cycle tests (Table 26) were cyclosized and forwarded to RPC for mineralogical study.

7.2 Results

The use of lime instead of soda ash-sulphur dioxide gave a much more selective copper rougher flotation stage due to improved depression of pyrite/middlings. As can be seen in Table 27, the weight of material recovered was reduced by about half with lime. Zinc contamination losses were also reduced by the same amount. However, copper rougher recoveries decreased by approximately 10%. Because of this, soda ash was used in most of the locked cycle tests in order to give regrinding mill a chance to liberate any chalcopyrite/sphalerite/pyrite middlings.

Lime was used in copper rougher flotation for one locked cycle test on the HIGH Zn zone. The copper cleaner concentrate grade increased from just over 10% (with soda ash) to 18.5% (Table 28). However, copper recovery fell from 50 to 36.5%. Gold and silver (apparently associated with pyrite/arsenopyrite) recoveries also dropped at the same time by a few percentage points due to the lower recovery of pyrite to the copper cleaner concentrate.

The locked cycle test results are summarized in Table 28. Copper metallurgy for the HIGH Zn zone improved significantly as the primary grind was increased to over 90% passing 400 mesh (Figure 8). The best copper results that were achieved were still very discouraging with only 50% recovery at 20% concentrate grade. Copper results for the UPPER and LOWER zones were only marginally better than those for the HIGH Zn zone. The main copper losses were still to the flotation tailings, presumably as fine intergrowths in the pyrite and/or silicate/cabonate gangue.

Precious metals recoveries in the copper concentrate were very poor. Gold recovery for the HIGH Zn zone was about 10% (at 20% copper concentrate grade) and 5% or lower for the other two zones. Silver recovery was around 10% for the LOWER composite but less than 5% for the HIGH Zn and UPPER zones.

At 20% grade, zinc losses in the copper concentrate were about 0.5% for the HIGH Zn zone (7% Zn content) and 1-2% for the UPPER and LOWER zones (3% Zn content).

Zinc metallurgy for the HIGH Zn zone was considerably more promising than the copper results above. High grade concentrates (54% plus) were readily produced. Zinc recovery increased from just over 70% at a primary grind of 75% -400 mesh to 85% at a grind of 95% -400 mesh. However, zinc circuit reagent dosages and flotation times had to be raised significantly to maintain recovery at this extreme fineness.

Zinc metallurgy for the two low grade zones was quite similar with concentrate grades of 50% zinc and recoveries of 55% at a grind of 75% -400 mesh. Approximately 80% of the total zinc losses was in the zinc rougher circuit tailings (as opposed to the cleaner circuit tailings). Grinding to over 90%

-400 mesh as for the HIGH Zn zone could be expected to increase zinc recovery somewhat.

Metallurgical predictions for the three ore zones based on the results achieved in the extensive bench test flotation program and at a primary grind of at least 90% -400 mesh are shown in Table 29. These predictions are used for the preliminary economic evaluation of the Point Leamington Deposit as detailed in section 9.

8. QUANTITATIVE EVALUATION OF EXTENSIVE BENCH TEST PRODUCTS (from RPC report MDP/87/17)

8.1 Method

Polished grain mounts were prepared of eighty-three cyclosizer size fractions of products from the locked cycle test program (Table 26). Thirty-five of the samples were examined in detail using the electron microprobe and automated image analyzer. The remaining forty-eight samples were examined optically. Mineral distributions, liberation of chalcopyrite and sphalerite and the nature of the locked phases were determined. Visual estimates were made for the samples examined optically.

8.2 Results

Data on mineral distributions, liberation of chalcopyrite and sphalerite and the nature of the locked phases for the products from the four locked cycle tests are summarized in Tables 30-33.

Copper cleaner concentrate grades were poor due mainly to the large amounts of locked and liberated pyrite brought in with the chalcopyrite. Chalcopyrite liberation dropped significantly at the coarsest size fractions. In the two tests on the HIGH Zn zone (Test 38 copper concentrate 7.3% Cu, Test 39 18.5% Cu), the chalcopyrite liberation dropped from about 70% in the +7.5 micron fraction to 30-50% in the +25 micron fraction. In both of these tests, the overall chalcopyrite liberation was determined with the image analyzer to be around 60%. Sixty percent of the locked chalcopyrite was classified as coarse

intergrowths and inclusions (chalcopyrite 55-85% of the particle).

A large amount of the sphalerite recovered to the copper concentrates on the HIGH Zn zone tests was unliberated (~30% liberation). Fifty to sixty percent of the locked sphalerite was rated coarse intergrowths and inclusions. Although the sphalerite content of the copper concentrates in the UPPER and LOWER tests was considerably lower than for the HIGH Zn zone, the overall sphalerite liberation was determined visually to be about 80%.

Finer regrinding in the copper circuit would appear to have significant potential for improving the quality of the copper concentrate.

Chalcopyrite in the zinc cleaner concentrates was mostly as fine to coarse intergrowths and inclusions in sphalerite and pyrite. Overall chalcopyrite liberation generally averaged 40% or lower and ranged from 70-90% in the +8 micron fraction to below 30% above 20 microns.

Sphalerite liberation in all of the zinc cleaner concentrates was similar at 89-93%. In the coarsest fractions, liberation dropped off to 75-80% (coarse intergrowths and inclusions for the most part). Regrinding below 20 microns would eliminate many of these locked particles.

Chalcopyrite liberation in the two tailings streams - zinc cleaner scavenger tailings and zinc rougher circuit tailings - was extremely poor, usually below 10%. In addition, the intergrowths and inclusions were mainly (80%) rated as fine. The potential for substantially improving copper recoveries even with extremely fine primary grinding (10 or 20 microns) appears limited.

As had been found in the previous mineralogical evaluations, the sphalerite mineralization was considerably coarser than the chalcopyrite. Liberation in the zinc cleaner scavenger tailings was approximately 60%. Liberation in the zinc rougher tailings was somewhat lower at 30-50%. In both cases, the proportion of coarse intergrowths and inclusions was high (45-60%) and zinc metallurgy would benefit from additional grinding. In tests with lower than expected zinc recovery (tests 38 and 39), a significant amount of coarse sphalerite was lost confirming the need for increased collector dosages and

flotation times that were employed successfully later in the testing program (test 45, for example).

In summary, increased grinding would be expected to have the biggest effect on zinc metallurgy. Although copper concentrate grade could be improved substantially by finer grinding and/or regrinding and more selective flotation, copper recoveries would remain relatively low.

9. IDENTIFICATION OF GOLD AND SILVER CARRYING MINERALS

9.1 Method

Several high gold and silver content core samples were forwarded to RPC in July 1987 from Noranda Exploration Company. The samples and their analyses are listed in Table 34. These samples, along with the copper cleaner concentrates from tests 36 and 37 were examined optically for traces of native gold or silver. Gold in six of the core samples was searched for using the electron microprobe and image analyzer. Finally, various phases within two of the samples were probed to look for solid solution gold and silver.

9.2 Results

No native gold or silver was observed in the optical examination of the various samples although some had been reported in other samples by D.J.T. Carson, Noranda Exploration Ltd. (personal communication).

The microprobe/image analyzer search also found no native gold or silver. At the magnification used, the smallest particle that could be measured by the image analyzer was 2.5 microns in diameter. The only occurence of gold was found in a small 2 micron silver/gold telluride grain in sample 6185G. The grain occurred between two larger galena grains on a sphalerite/pyrite border. Three other small telluride grains (gold-free) were found - 2 in sample 6188G (also contained lead and sulphur) and one in sample 6188H (also contained molybdenum and silver).

Traces of silver were found inconsistently in solid solution in some of the sphalerite, chalcopyrite, arsenopyrite and pyrite probed in samples 6185G and 6188H (Table 35). The galena in sample 6188H contained no silver. No gold was found in any of the samples. Although the silver appeared to be present in solid solution, the possibility exists for very small silver bearing inclusions within the phases or large grains just below the surface.

10. PRELIMINARY ECONOMIC ASSESSMENT

10.1 Ore Reserves

The updated ore reserve for Point Leamington, based on the results of additional drilling by Noranda Exploration in 1987, has been estimated at 13.2 million tonnes grading 2.25% Zn, 0.48% Cu, 20.9 ppm Ag and 0.9 ppm Au (almost identical to UPPER zone composition)([4]). During the 1987 drilling program, it had been hoped to discover larger reserves of high grade zinc-gold ore. However, actual results were very discouraging. The high grade reserves have now been evaluated at only 1.5 million tonnes (included in total reserves above) at 7.3% Zn, 0.43% Cu, 54.7 ppm Ag and 2.25 ppm Au. Although the copper and silver contents are close to those of the HIGH Zn zone tested, the zinc and gold contents are more than 40% lower.

10.2 Low Grade Ores

Based on the predicted metallurgical results in Table 29 for the UPPER and LOWER zones, the preliminary estimated net smelter return for low grade (average) Point Leamington ore is less than $13/tonne (Table 36). Revenue from gold and silver is almost negligible due to the very low recoveries. Given that mine operating costs (mining and processing) for underground massive sulphide deposits are typically at least $30-50/tonne of ore, it is readily apparent that the bulk of the Point Leamington reserves are extremely uneconomic. Point Leamington operating costs would probably be higher than normal due to the need for extremely fine grinding. Substantial increases in metal recoveries, prices and feed content would all be required to begin to change this overall gloomy economic picture. Unfortunately, none of the above appears highly probable.

10.3 High Grade Ore

A similar preliminary economic analyses for the 1.5 million tonnes of higher grade ore is shown in Table 37. The net smelter return, over 75% of which comes from zinc concentrate revenue, increased to about $40/tonne ore. Although this is more in line with expected operating costs, the small size of the ore reserves at this grade would not sustain a viable operation for the time required to pay back the substantial capital cost outlay that would be required to exploit the orebody.

The net smelter return for the HIGH Zn zone ore was estimated at over $70/tonne ore (Table 38) due to its elevated zinc content. Unfortunately, as above, no significant quantity of this material has been delineated by the substantial drilling that has been conducted.

11. CONCLUSION

1. The metallurgical response of one high grade and two low grade samples from the Point Leamington deposit have been extensively studied.

2. Two series of flotation tests were conducted with sized products from each being evaluated in detail for mineral distributions and liberations using an electron microprobe interfaced with an automated image analyzer.

3. The three Point Leamington samples can be classified as extremely fine-grained massive sulphides (predominantly pyrite). Eighty percent of the sphalerite and 90% of the chalcopyrite were found to be present as grains finer than 10 microns except for sphalerite in the HIGH Zn zone which had a K80 of 22 microns (more massive sphalerite present).

4. A primary grind of 90% or more passing 400 mesh was found necessary to achieve acceptable results. Regrinding, especially in the copper circuit, was required to produce saleable concentrate grades.

5. Copper metallurgical results were similarly poor for the three ore samples. Copper recoveries of 50% were achieved at concentrate grades of 20% copper.

Copper losses were almost exclusively as very fine inclusions, mainly in pyrite. Little promise was shown to significantly improve copper metallurgy.

6. Sphalerite mineralization was somewhat coarser than the chalcopyrite. Excellent zinc results (54% concentrate grade at 85% zinc recovery) were achieved for the HIGH Zn zone at a primary grind of 90% -400 mesh or better. High reagent dosages and long flotation times were required, however, to maintain recoveries at these fine particle sizes.

7. Zinc results for the two low grade samples were considerably inferior - 50% concentrate grade at about 60% recovery.

8. Selectivity between chalcopyrite and sphalerite was reasonably good with zinc losses to the copper concentrate being below 2% for the two low grade ores and around 0.5% for the HIGH Zn ore.

9. Gold and silver recoveries to the copper concentrate were poor at 10% or less. The precious metals appear to be associated mainly with pyrite and/or arsenopyrite. No gold carrying mineral was identified although silver was detected in solid solution (or as ultrafine inclusions) in several of the sulphide minerals.

10. The total ore reserves of the Point Leamington deposit are estimated at 13.2 million tonnes (2.25% Zn) including only 1.5 million tonnes of high grade (7.3% Zn, 2.25 ppm Au, 0.43% Cu) ore. A preliminary economic analysis found little promise for the deposit without the discovery of considerable additional tonnages of high grade material.

11. The results of the present study are in agreement with previous work conducted in 1971-75.

REFERENCES

1. Varshney, S.C., Brunswick Mining, Metallurgical testwork on Pt. Leamington concession ore, Internal Report, January 1974.

2. Larouch, M. and Schultz, S., Noranda Ore Dressing Laboratory, Point Leamington Report #4, Internal Report, 20 January 1975.

3. Petruk, W., CANMET, The MP-5EM-1P5 image analysis system and its applications to mineralogy and geochemistry, CANMET Report 86-78, 1986.

4. Jarvi, U.W., Noranda Minerals, Report on geology and ore reserves of the Point Leamington massive sulphide deposit East Central Newfoundland, 31 December 1987.

TABLE 1 - RESULTS OF BRUNSWICK LOCKED CYCLE TEST P110-336-341, 25 OCT/73

	Wgt %	Assay, % or opt				% Distribution			
		Cu	Zn	Ag	Au	Cu	Zn	Ag	Au
Cu Conc	2.15	15.05	3.93	2.75	.052	53.3	2.2	6.8	2.1
Zn Conc	6.05	0.45	48.96	1.57	.051	4.5	76.1	10.9	5.8
Tail	91.80	0.28	0.92	0.78	.053	42.2	21.7	82.3	92.1
Head	100	0.61	3.89	0.90	.053	100	100	100	100

TABLE 2 - POINT LEAMINGTON ORE SECTIONS

ZONE		UPPER				LOWER			HIGH Zn
Drill Hole		L-1	L-2	L-3	L-4	L-1	L-2	L-3	L-1
Interval meters	Top	0	0	0	29.8	81.7	80.6	50.6	126.0
	Bottom	53.2	25.3	39.0	72.7	126.0	164.9	124.0	147.5
Weight kgs		280	95	190	220	310	205	330	110
Cu, %		0.56	0.32	0.40	0.40	0.45	0.36	0.96	0.48
Zn, %		2.83	1.78	2.40	2.11	3.42	2.16	2.18	12.67
Pb, %		0.16	0.28	0.17	0.20	0.31	0.19	0.15	0.37
Au, ppm		2.4	2.0	2.1	2.0	3.1	2.2	2.6	3.8*
Ag, ppm		16.2	20.5	20.0	18.6	40.2	10.5	11.2	43.0
As, %		0.64	0.35	0.18	0.29	0.46	0.66	0.34	1.54
SiO_2, %		24.0	22.8	19.5	22.9	11.7	17.6	17.4	8.15
Al_2O_3, %		0.94	0.30	0.26	0.19	0.23	0.76	0.42	0.85
TiO_2, ppm		415	48	90	42	33	353	117	195
Total Fe AsFe_2O_3, %		37.52	38.61	41.17	38.6	43.8	39.52	43.13	38.58
K_2O, %		<0.5	<.05	<.05	<.05	<.05	<.05	<.05	0.07
Na_2O, %		0.07	0.08	<.05	<.05	<.05	<.05	<.05	<.05
CaO, %		0.28	1.09	0.39	0.55	0.17	0.38	0.25	2.06
MgO, %		0.45	0.17	0.17	0.08	0.09	0.33	0.17	0.25
MnO, ppm		494	334	253	365	566	305	364	601
L.O.I., %		22.99	24.68	24.67	23.55	27.78	25.52	24.54	23.5
Ba, ppm		108	61	117	69	70	73	61	69
Sr, ppm		<20	<20	<20	<20	<20	<20	<20	<20
Bi, ppm		71	82	86	78	56	85	100	87
S, %		33.6	34.1	37.3	34.5	40.9	35.1	38.0	34.3
Sb, ppm		752	863	861	828	1198	1006	995	963

* Average assay calculated from flotation tests

TABLE 3 - POINT LEAMINGTON ZONE COMPOSITE ASSAYS

UPPER

Test	%Cu	%Zn	ppm, Au	ppm, Ag
2	.46	2.37		
5	.44	2.32	0.66	20.1
17	.51	2.64		
21	.43	2.34		
22	.44	2.33		
23	.43	2.25		
28	.45	2.27		
30	.42	2.26		
34	.40	2.13		
37	.45	2.22	0.64	18.4
AVG	0.44	2.31	0.65	19.3

HIGH Zn

3	.36	13.9		
6	.41	13.9	3.9	49.4
24	.42	13.1		
25	.42	12.9		
29	.42	13.4		
32	.41	12.6		
33	.39	12.4		
38	.43	12.6	4.0	50.2
39	.43	13.2	3.7	47.7
40	.44	12.1	3.9	48.9
41	.43	12.2	3.8	47.2
42	.46	12.0	3.8	47.8
43	.46	12.7		
44	.47	12.2		
45	.46	12.8		
AVG	0.43	12.8	3.9	48.5

LOWER

Test	%Cu	%Zn	ppm, Au	ppm, Ag
1	.60	3.07		
4	.59	2.81		25.2
7	.61	2.86	1.3	26.1
8	.58	3.22	1.3	31.6
9	.59	2.77	1.3	28.9
10	.58	3.24	1.3	37.6
11	.62	3.18	1.3	28.2
12	.55	3.30	1.4	30.2
13	.57	2.55	1.3	29.3
14	.60	2.97	1.4	29.1
15	.57	3.18	1.3	26.2
16	.58	3.08		
18	.54	2.81		
19	.53	2.70		
20	.54	2.72		
26	.56	2.65		
27	.42	2.82		
31	.55	2.57		
35	.55	2.55		
36	.59	2.64	1.3	24.9
AVG	0.57	2.88	1.3	28.8

TABLE 4* - LIST AND APPROXIMATE POSITIONING OF SAMPLES IN THE DRILLCORE

Drill Hole	Ore Zone	Sample #	Position (±0.10 m)	Box Number
L-1	Upper Low Grade	6119	11.9 m	2
		6120	14.6 m	2
		6121	20.5 m	4
		6122 TS	33.8 m	7
		6123	47.4 m	9
		6124	50.65 m	10
	Lower Low Grade	6134	87 m	20
		6135	95.5 m	22
		6136	108.2 m	24
		6137	123.75 m	28
	High Zinc	6125	126.2 m	29
		6126	129.45 m	29
		6127 (A and B)	130.45 m	29
		6128	134 m	30
		6129	134.5 m	30
		6130	139.8 m	32
		6131 (A and B)	143.5	33
		6132	144 m	33
		6133	147.5 m	33
L-2	Upper Low Grade	6138	11.6 m	1
		6139	13.1 m	2
		6140 (A and B)	16 m	2
	Lower Low Grade	6141	81.1 m	18
		6142	91.1 m	20
		6143	160.7 m	36
		6144 TS	164.9 m	36
L-3	Upper Low Grade	6145	11.3 m	1
		6146	11.7 m	1
		6147 TS	15.95 m	2
		6148	35.75 m	7
	Lower Low Grade	6159	54.2 m	11
		6160	68.4 m	12
		6161	59 m	13
		6162	100.7 m	22
		6163	102.1 m	23
		6164	109 m	24
		6165 (A and B)	120.7 m	27
L-4	Upper Low Grade	6149	33.6 m	6
		6150	36.3 m	7
		6151	40.65 m	8
		6152	45.7 m	9
		6153	50.6 m	10
		6154 (A and B)	61.8 m	13
		6155	63.25 m	13
		6156 (A and B)	72.35 m	15
		6157	71.05 m	15
		6158	71.7 m	15

* from RPC Report MDP/86/11

TABLE 5 - POINT LEAMINGTON DEPOSIT - GENERAL GRAIN TEXTURE TYPES

TYPE	GENERAL DESCRIPTION
1	gangue and FeS_2 (<50%), 15% associated $CuFeS_2$, ZnS, PbS, FeAsS, SnO_2. Fe_7S_8 often present within FeS_2. FeS_2 disseminated to framboidal, granular or enhedral
2	FeS_2 (50-100%) and gangue with 15% other as above in 1. FeS_2 also granular massive, spongy massive or recrystallized massive
3	FeS_2, gangue and 15-50% ZnS. Other minerals <10%. ZnS interstitial to FeS_2 which is recrystallized when in contact with ZnS
4	ZnS >50% and at least 10% PbS and somewhat less gangue as large inclusions. Other minerals present as small inclusions
5	as type 4 but lower PbS
6	mainly ZnS with <25% inclusions
7	FeS_2 and gangue with FeAsS that exhibits same habit as FeS_2. Small inclusions/intergrowths other minerals
8	predominantly Fe_7S_8 with inclusions
9	silicate/carbonate phases with <10% sulphides/SnO_2
10	material containing FeAsS that exhibits atoll or hallow texture. "Clouds" of finer FeAsS also present
11	mosaic of intergrown FeS_2, ZnS, $CuFeS_2$, Fe_7S_8, gangue and sometimes FeAsS and amounts

FeS_2	pyrite	PbS	galena	SnO_2	cassiterite
FeAsS	arsenopyrite	$CuFeS_2$	chalcopyrite		
ZnS	sphalerite	Fe_7S_8	pyrrhotite		

TABLE 6 - GENERAL MINERAL ABUNDANCE IN POINT LEAMINGTON ORE ZONES

Mineral	Upper	Lower	High Zn
Pyrite	Major	Major	Major
Quartz	"	"	"
Calcite	Common	Common	Common
Sphalerite	"	"	Major
Chalcopyrite	"	"	Common
Pyrrhotite	Trace	"	"
Chlorite	Common	"	
Arsenopyrite	Trace	Trace	Common
Galena	"	"	"
Cassiterite	"	"	Trace
Fe-rich Chlorite	"	"	"
Wollastonite		"	"
Apatite			"
Siderite			Common

Major : A major component in most samples
Common : A minor component in most samples but can be a major component in some
Trace : A very minor component in some samples

TABLE 7 - IMPORTANT FEATURES OF MINERAL OCCURENCES

Mineral	Upper and Lower	High Zn
Sphalerite	- most commonly fine irregular intergrowths or inclusions within pyrite 1-75 microns across and no more than 5% of material - more abundant in lower half of zone where also occurs as lenses up to 10-20 cm long and 500 microns wide, small lenses inclusions pyrite, larger lenses other materials such as PbS, pyrrhotite, SnO_2, FeAsS	- most common as layers and lenses of massive ZnS although also as intergrowths and inclusions in pyrite - inclusions generally less than 15% of ZnS and usually about 50 microns in size - also intrusions of massive sulphides with Zn 40-60% and finely intergrown with chalcopyrite, pyrrhotite and sometimes PbS
Chalcopyrite	- fine intergrowths or inclusions in pyrite with or without ZnS, however locally can be up to 20-30% of material - in upper zone can occur in quartz veins - in lower zone also seen as inclusions in pyrrhotite	- most commonly as inclusions or intergrowths (<175 micron in length) associated with ZnS intruding pyrite - also as small inclusions, intergrowths and stringers in pyrite
Arsenopyrite	- generally as inclusions in ZnS lenses - also as "clouds" in pyrite	- as for other two zones plus several other unusual habits
Pyrrhotite Galena Cassiterite	- generally as small inclusions in ZnS masses	- generally as inclusions in massive ZnS
Veins	- more abundant in upper, two types - fine (<5 mm) quartz veins, some chalcopyrite in upper, otherwise barren calcite veins	- not common, but do occur - calcite veins most abundant - also small (<100 microns wide) quartz veins
Other	- upper zone basic intrusions in two holes - L-1 2 meters wide felsic rock with trace inclusions pyrite and chalcopyrite - L-3 0.5 meter wide also with inclusions as above	- basic intrusion 4 meters wide - mostly barren with few sulfides - similar to intrusions in upper zone

TABLE 8 - AVERAGE SPHALERITE COMPOSITION IN VARIOUS ZONES

Zone	No. of Determinations	Zn	% Fe	S
Upper	39	61.3	4.9	33.8
Lower	22	61.8	4.7	33.5
High Zn	28	60.3	6.3	33.4

TABLE 9 - DISTRIBUTION BY GENERAL TEXTURE TYPE (Textures as defined in Table 5)

Texture	UPPER L-1	UPPER L-2	UPPER L-3	UPPER L-4	LOWER L-1	LOWER L-2	LOWER L-3	HIGH Zn L-1
1	40	55	42	52	6	34	39	14
2	48	39	52	38	73	43	47	29
3	1	1	1	3	13	8	2	11
4	0	0	0	0	1	0	0	1
5	3	0	0	0	4	2	2	22
6	1	0	0	0	0	1	0	2
7	2	2	0	1	2	4	0	3
8	0	0	1	0	0	0	9	0
9	4	3	4	8	1	10	1	7
10	0	0	0	0	0	0	0	4
11	1	0	0	0	0	0	0	7

TABLE 10 - DISTRIBUTION OF PHASES

PHASE	PHASE DISTRIBUTION, % UPPER L-1	UPPER L-2	UPPER L-3	UPPER L-4	LOWER L-1	LOWER L-2	LOWER L-3	HIGH Zn
Sphalerite	3.7	2.2	1.9	2.5	8.2	2.2	3.3	16.0
Chalcopyrite	1.1	0.6	0.7	0.8	1.9	1.2	1.5	0.6
PbS/FeAsS, SnO_2	0.1	0.1	0.1	0.2	0.4	0.1	0.1	-
FeAsS/pyrite	-	-	-	-	-	-	-	1.4
PbS/SnO_2	-	-	-	-	-	-	-	0.4
Pyrite	51.1	56.1	58.6	45.5	66.0	52.3	48.4	44.2
Pyrrhotite	0	0.1	0.4	5.9	0.01	0.02	8.7	0.9
Silicates/Carbonates	44.0	40.9	38.3	45.1	25.5	44.2	38.0	36.5

PbS Galena
FeAsS Arsenopyrite
SnO_2 Cassiterite

TABLE 11 - SIZE DISTRIBUTION OF PHASES - UPPER ZONE

HOLE	PHASE	SIZE INTERVAL MICRONS -4.6	+4.6 -9.2	+9.2 -18.4	+18.4 -36.8	+36.8	K80* Microns	K90* Microns
L-1	Sphalerite	52	27	11.5	6.1	3.4	8.1	
	Chalcopyrite	84.5	12	2.3	0.8	0.4		5.1
	Pyrite	36.4	23	19.5	14.2	6.9		
	Pyrrhotite	100	0	0	0	0		
	PbS/FeAsS/SnO_2	95.2	3.6	0.6	0.6	0		
	Silicates/Carbonates	45.8	19.6	14.6	10.7	9.3		
L-2	Sphalerite	59.6	26.0	10.1	3.6	0.7	6.3	
	Chalcopyrite	80.7	15.1	3.7	0.5	0		5.4
	Pyrite	36.6	22	19.4	14.2	7.8		
	Pyrrhotite	53.0	34.3	9.1	3.6	0		
	PbS/FeAsS/SnO_2	88.9	10.1	1.0	0	0		
	Silicates/Carbonates	44.3	18.2	14.3	11.8	11.4		
L-3	Sphalerite	72.3	21.0	5.4	1.2	0.1	4.7	
	Chalcopyrite	86.7	11.0	2.2	0.1	0		4.3
	Pyrite	36.7	21.0	19.2	14.4	8.7		
	Pyrrhotite	44.2	32.0	14.2	6.4	3.2		
	PbS/FeAsS/SnO_2	86.9	13.1	0	0	0		
	Silicates/Carbonates	39.9	20.4	14.1	11.3	14.3		
L-4	Sphalerite	69.8	20.6	6.6	2.4	0.6	5.2	
	Chalcopyrite	80.4	13.1	5.3	1.0	0.2		6.1
	Pyrite	36.1	23.0	19.8	13.8	7.3		
	Pyrrhotite	33.7	26.0	20.6	13.2	6.5		
	PbS/FeAsS/SnO_2	63.9	17.0	13.5	4.2	1.4		
	Silicates/Carbonates	33.3	19.5	16.9	14.1	16.2		

TABLE 12 - SIZE DISTRIBUTION OF PHASES - LOWER ZONE

HOLE	PHASE	SIZE INTERVAL MICRONS -4.6	+4.6 -9.2	+9.2 -18.4	+18.4 -36.8	+36.8	K80* Microns	K90* Microns
L-1	Sphalerite	50.9	24.0	14.5	6.7	3.9	9.6	
	Chalcopyrite	88.5	9.1	2.1	0.3	0		4.1
	Pyrite	36.5	23.0	19.6	14.1	6.8		
	Pyrrhotite	73.9	27.1	0	0	0		
	PbS/FeAsS/SnO_2	83.9	10.3	4.4	1.2	0.2		
	Silicates/Carbonates	49.3	20.5	14.1	9.9	6.2		
L-2	Sphalerite	60.5	24.7	10.3	3.7	0.8	6.3	
	Chalcopyrite	89.9	7.8	1.9	0.4	0		3.8
	Pyrite	38.9	21.0	19.1	13.5	7.5		
	Pyrrhotite	46.7	46.6	6.7	0	0		
	PbS/FeAsS/SnO_2	90.7	7.6	1.7	0	0		
	Silicates/Carbonates	42.5	19.1	14.7	11.4	12.3		
L-3	Sphalerite	53.1	30.0	12.2	3.9	0.8	7.0	
	Chalcopyrite	75.1	17.1	5.9	1.4	0.5		6.9
	Pyrite	45.5	22.0	16.3	10.6	5.6		
	Pyrrhotite	32.7	23.0	15.9	14.7	13.7		
	PbS/FeAsS/SnO_2	88.0	9.0	3.0	0	0		
	Silicates/Carbonates	50.8	19.2	13.8	9.6	6.6		

*K80 chord size below which 80% of chord lengths fall
*K90 chord size below which 90% of chord lengths fall

TABLE 13 - SIZE DISTRIBUTION OF PHASES - HIGH Zn ZONES

HOLE	PHASE	SIZE INTERVAL MICRONS					K80* Microns	K90* Microns
		-4.6	+4.6 -9.2	+9.2 -18.4	+18.4 -36.8	+36.8		
L-1	Sphalerite	33.1	20.1	18.1	14.7	14.0	22	
	Chalcopyrite	75.8	16.4	4.6	2.4	0.8		6.8
	Pyrite	26.9	20.9	18.7	16.9	16.6		
	Pyrrhotite	45.1	27.0	19.6	7.9	0.4		
	Galena/Cassiterite	82.0	13.4	3.5	1.1	0		
	Arsenopyrite	62.3	20.0	10.6	5.1	2.0		
	Silicates/Carbonates	42.6	18.6	14.7	10.7	13.4		

*K80 chord size below which 80% of chord lengths fall
*K90 chord size below which 90% of chord lengths fall

TABLE 14 - REAGENTS USED DURING FLOTATION TESTWORK

REAGENT	SUPPLIER	ADDITION METHOD
Soda Ash Na_2CO_3		dry powder
Hydrated Lime $Ca(OH)_2$		dry powder
Sulphur Dioxide SO_2	Anachemia	6% sulphurous acid solution
Sodium Cyanide NaCN		5% solution
Copper Sulphate $CuSO_4.5H_2O$		5% solution
Aerofroth 65 Frother	Cyanamid	0.5% solution
Sodium Isopropyl Xanthate (R-343)	Cyanamid	0.5% solution
Aero 4037 Promoter	Cyanamid	pure
Sulphuric Acid	Allied Chemicals	10% solution
Potassium Amyl Xanthate (R-350)	Cyanamid	0.5% solution

TABLE 15 - PRELIMINARY BENCH TESTS

Test	Composite	Grind % -400 Mesh	Description
1	Lower	44]	
2	Upper	49]	exploratory flotation tests Na_2CO_3-SO_2-aeration
3	High Zn	65]	incremental copper, zinc rougher concentrates
4	Lower	64]	
5	Upper	65]	regrinding cleaning copper, zinc
6	High Zn	63]	
7	Lower	64]	
8	Lower	65]	
9	Lower	65]	
10	Lower	65]	Na_2CO_3 vs CaO in copper circuit
11	Lower	65]	SO_2, NaCN for zinc depression
12	Lower	65]	effect of aeration
13	Lower	65]	
14	Lower	65]	
15	Lower	78	finer grind, increased reagents
16	Lower	78]	CaO in copper circuit
17	Upper	78]	
18	Lower	78]	
19	Lower	62]	
20	Lower	54]	
21	Upper	78]	produce products for mineralogical
22	Upper	65]	study at different primary grinds
23	Upper	49]	
24	High Zn	72]	
25	High Zn	65]	

TABLE 16 - SIZE OF ROD MILL FEED SAMPLES

Size Mesh	Composite, wgt % retained		
	Upper	Lower	High Zn
+6	3.1	2.2	3.2
+8	15.6	14.8	18.0
+12	19.3	20.8	19.9
+16	15.7	17.0	15.5
+20	10.9	11.3	10.5
+30	8.8	8.8	8.5
+40	5.5	5.5	5.3
+50	4.7	4.6	4.5
+70	3.2	3.3	3.0
+100	2.4	2.6	2.3
-100	10.8	9.1	9.3

TABLE 17 - GOLD AND SILVER RECOVERIES IN ROUGHER FLOTATION

Test	Zone	Product	Weight %	Assay, ppm Au	Assay, ppm Ag	% Distribution Au	% Distribution Ag
5	Upper	Cu Rgh Conc	14.7	0.91	26.4	20.2	19.3
		Zn Rgh Conc	11.8	0.55	26.6	9.8	15.6
		Feed		0.66	20.1		
15	Lower	Cu Rgh Conc	11.4	1.61	1.7	14.2	24.8
		Zn Rgh Conc	10.0	1.16	1.2	10.7	16.2
		Feed		1.30	0.76		
6	High Zn	Cu Rgh Conc	15.9	6.6	58.1	26.6	18.7
		Zn Rgh Conc	24.2	2.9	53.1	17.7	26.0
		Feed		3.94	49.4		

TABLE 18 - PRELIMINARY TEST PRODUCTS CYCLOSIZED

Zone	Product	Test(s)
Upper	Cu Conc	18-20 (blended)
	Zn Conc	18-20 (blended)
	Tailing	18
	Tailing	18
Lower	Cu Conc	21
	Zn Conc	21-23 (blended)
	Tailing	21
	Tailing	23
High Zn	Cu Conc	24
	Zn Conc	24
	Tailing	24

TABLE 19 - CYCLOSIZING - TEST 21 COPPER CONCENTRATE

	Size, Mesh or Microns	Wgt %	Assay, % or g/T Cu	Assay, % or g/T Zn	Assay, % or g/T Au	% Distribution Cu	% Distribution Zn	% Distribution Au
	+200 mesh	0	0	0	0	.00	.00	.00
	+270 mesh	3	1.17	1.18	(1)	1.57	1.65	2.45
	+30.5 mic	24.1	.91	.87	1.32	9.81	9.75	26.02
	+23.6	16.2	1.25	1.3	.92	9.06	9.79	12.19
	+16.5	21.4	1.69	1.82	.9	16.18	18.11	15.75
	+11.3	14.4	2.4	2.86	.97	15.46	19.15	11.42
	+8.8	6.4	3.25	3.66	1.16	9.31	10.89	6.07
	-8.8	14.5	5.95	4.55	2.2	38.60	30.67	26.09
Calc	Head	100	2.23	2.15	1.22	100	100	100
Assay	Head		2.13	1.99	.99			

TABLE 20 - CYCLOSIZING - TEST 21-23 ZINC CONCENTRATE

	Size, Mesh or Microns	Wgt %	Assay, % or g/T Cu	Zn	Au	% Distribution Cu	Zn	Au
Upper	+200 mesh	0	0	0	0	.00	.00	.00
Zone	+270 mesh	6.6	.3	23.3	1.25	7.09	4.60	9.50
	+33.2 mic	13.6	.27	20.7	1.04	13.15	8.42	16.29
	+25.7	18.2	.26	26.3	.81	16.95	14.32	16.98
	+18	18.2	.25	31.8	.62	16.30	17.31	13.00
	+12.3	12.8	.19	40.3	.66	8.71	15.43	9.73
	+9.5	6.9	.19	45.1	.7	4.70	9.31	5.56
	-9.5	23.7	.39	43.2	1.06	33.11	30.62	28.94
		100	.28	33.44	.87	100	100	100
Calc	Head		.31	32.5	.73			
Assay	Head							

TABLE 21 - CYCLOSIZING - TEST 21 TAILING

	Size, Mesh or Microns	Wgt %	Assay, % or g/T Cu	Zn	Au	% Distribution Cu	Zn	Au
Upper	+200 mesh	0	0	0	0	.00	.00	.00
Zone	+270 mesh	8.8	.21	.68	.69	14.05	14.24	9.35
	+35.3 mic	18.9	.2	.54	.84	28.74	24.29	24.45
	+27.3	13.5	.16	.43	.68	16.42	13.81	14.14
	+19.1	17.1	.09	.3	.52	11.70	12.21	13.69
	+13.1	11.3	.08	.2	.5	6.87	5.38	8.70
	+10.1	5.9	.08	.19	.55	3.59	2.67	5.00
	-10.1	24.5	.1	.47	.654	18.63	27.40	24.67
		100	.13	.42	.65	100	100	100
Calc	Head		.15	.46	.72			
Assay	Head							

TABLE 22 - PRELIMINARY TEST PRODUCTS CHOSEN FOR DETAILED EXAMINATION

Zone	Test	Product	Size Fraction Microns	Assay, % or ppm Cu	Zn	Au
Upper	21	Copper Cleaner Conc	+8.8	3.25	3.66	1.16
			+16.5	1.69	1.82	0.90
	21-13 (mixed)	Zinc Cleaner Conc	+9.5	0.19	45.1	0.70
			+18.0	0.25	31.8	0.62
	21	Tailings	+10.1	.078	0.19	0.55
			+19.1	.091	0.30	0.52
Lower	18-20 (mixed)	Copper Cleaner Conc	+8.8	7.02	3.40	1.82
			+16.8	4.20	1.46	1.48
	"	Zinc Cleaner Conc	+12.1	0.35	40.9	0.80
			+25.3	0.43	36.6	0.92
	18	Tailings	+9.7	0.11	0.39	1.23
			+12.5	0.13	0.45	1.21
			+18.2	0.18	0.67	1.67
			+26.1	0.24	0.91	1.31
High Zn	24	Copper Cleaner Conc	+8.8	3.57	11.3	7.65
			+30.6	0.92	5.47	7.77
	24	Zinc Cleaner Conc	+9.6	0.12	55.8	1.28
			+12.4	0.12	54.2	1.54
			+18.1	0.12	52.4	2.01
			+25.9	0.14	49.0	2.67
	24	Tailings	+9.8	.072	0.80	2.79
			+26.4	.11	1.15	3.29
			+34.0	.14	1.15	4.48

TABLE 23 - LIBERATION OF CHALCOPYRITE AND SPHALERITE IN PRELIMINARY TEST PRODUCTS*

Zone	Test	Product	Size Fraction Microns	Chalcopyrite %	% Liberation	Sphalerite %	% Liberation
Upper	21	Copper Cleaner Conc	+8.8	8.50	37.9	6.27	26.7
			+16.5	4.44	29.8	3.04	27.3
	21-23	Zinc Cleaner Conc	+9.5	-	-	68.2	79.3
			+18.0	-	-	51.5	70.5
	21	Tailings	+10.1	.07	0.21	0.16	2.6
			+19.1	.19	0.84	0.32	0.1
Lower	18-20	Copper Cleaner Conc	+8.8	19.61	43.8	5.85	15.5
			+16.8	12.01	46.9	2.69	26.6
	18-20	Zinc Cleaner Conc	+12.1	-	-	62.7	65.1
			+25.3	-	-	54.8	64.6
	18	Tailings	+9.7	0.17	0.12	0.28	4.38
			+12.5	0.13	0.38	0.51	1.02
			+18.2	0.46	0.40	0.63	1.39
			+26.1	0.32	0	0.32	1.57
High Zn	24	Copper Cleaner Conc	+8.8	8.16	51.9	20.6	52.9
			+30.6	3.02	21.9	1.81	11.2
	24	Zinc Cleaner Conc	+9.6	-	-	87.5	85.8
			+12.4	-	-	85.5	89.1
			+18.1	-	-	78.7	78.1
			+25.9	-	-	79.4	70.6
	24	Tailings	+9.8	0.99	1.53	1.33	13.2
			+26.4	0.46	0.62	1.33	5.44
			+34.0	0.30	0.02	1.76	1.79

* All values based on surface area

TABLE 24 - INTERGROWTH OF CHALCOPYRITE AND SPHALERITE WITH OTHER MINERALS*

Zone	Test	Product	Size Fraction Microns	PHASE, % Chalcopyrite 0-30	30-60	60-80	LIB	Sphalerite 0-30	30-60	60-80	LIB
Upper	21	Copper Cleaner Conc	+8.8	14.3	23.7	24.1	37.9	19.8	25.5	28.0	26.7
			+16.5	31.3	22.6	16.3	29.8	33.8	16.6	22.3	27.3
	21-23	Zinc Cleaner Conc	+9.5	-	-	-	-	1.4	5.9	13.3	79.3
			+18.0	-	-	-	-	5.7	10.1	13.9	70.5
	21	Tailings	+10.1	95.0	3.6	1.2	0.2	69.7	15.1	12.6	2.6
			+19.1	97.4	1.7	0.1	0.8	89.9	7.6	2.4	0.1
Lower	18-20	Copper Cleaner Conc	+8.8	8.9	20.8	26.6	43.8	27.9	27.8	28.9	15.5
			+16.8	16.1	21.3	15.7	46.9	36.2	20.7	16.5	26.6
	18-20	Zinc Cleaner Conc	+12.1	-	-	-	-	3.0	11.4	20.4	65.1
			+25.3	-	-	-	-	6.5	14.3	14.5	64.6
	18	Tailings	+9.7	89.7	9.0	1.2	0.1	70.5	18.8	6.4	4.4
			+12.5	98.1	1.5	0	0.4	76.0	19.4	3.7	1.0
			+18.2	94.1	5.3	0.2	0.4	80.9	16.5	1.2	1.4
			+26.1	98.4	0.9	0.7	0	80.7	14.6	3.2	1.6
High Zn	24	Copper Cleaner Conc	+8.8	14.4	16.9	16.8	51.9	10.9	16.9	19.2	52.9
			+30.6	49.2	17.1	11.7	21.9	58.0	23.8	10.9	11.2
	24	Zinc Cleaner Conc	+9.6	-	-	-	-	0.4	2.8	7.8	85.8
			+12.4	-	-	-	-	0.6	2.5	7.8	89.1
			+18.1	-	-	-	-	1.2	4.9	15.9	78.1
			+25.9	-	-	-	-	2.0	7.5	15.9	70.6
	24	Tailings	+9.8	61.3	32.6	4.6	1.5	56.6	22.4	7.8	13.2
			+26.4	97.9	0.6	0.9	0.6	68.9	19.5	6.1	5.4
			+34.0	100	0	0	0	76.0	19.6	2.7	1.8

* % of chalcopyrite or sphalerite that comprises various ranges of area % of grains.
LIB = % liberated, 0-30% fine intergrowths or inclusions, 30-60% medium 60-80% coarse.
Based on Petruk, W. (1986) : The MP-SEM-IP5 Image Analysis System and its Application to Mineralogy and Geochemistry, CANMET report 86-78, page 25.

TABLE 25 - EXTENSIVE BATCH TESTS

--	Zone	Batch or Locked	Grind % -400 mesh	
26	Lower	Batch	75	]
27	Lower	"	"	]
28	Upper	"	"	] Preliminary tests with 2 kg charge
29	High Zn	"	"	]
30	Upper	"	"	]
31	Lower	"	"	]
32	High Zn	"	"	]
33	"	"	"	] lime vs soda ash-sulphur dioxide
34	Upper	"	"	]
35	Lower	"	"	]
36	Lower	Locked	"	soda ash]
37	Upper	"	"	"] Test products for mineralogical study
38	High Zn	"	"	"]
39	"	"	"	CaO]
40	"	"	"	]
41	"	"	80	]
42	"	"	60	]
43	"	"	99	] tests on high Zn at various primary grinds
44	"	"	87	]
45	"	"	94	]

TABLE 26 - CYCLOSIZING OF EXTENSIVE BATCH TEST PRODUCTS

Test	Product	Weight % in Size Interval						
		+270 mesh	Cone 1	Cone 2	Cone 3	Cone 4	Cone 5	Fines
36	Cu Cl Conc 3+4		14.6	14.8	20.5	17.1	8.5	24.5
37	Cu Cl Conc 2-4		20.2	16.3	21	16.6	7.4	18.5
38	Cu Cl Conc 3+4		33.4	19.4	18.9	12	4.6	11.7
39	Cu Cl Conc 1-4		17.6	19.5	24.9	17.4	6.9	13.7
36	Zn Cl Conc 3+4		4.9	8.2	17.7	19.2	11.7	38.3
37	"		6.7	10.3	20.1	19.7	10.9	32.3
38	"	.9	18.6	16.6	20.7	16	7.5	19.7
39	"	.9	20.8	17.7	21.6	16.3	7.2	15.5
36	Zn Cl Sc Tl 3+4	3.1	8.6	8.7	14.2	15.3	9	41.1
37	"		10.4	10.9	17.1	17	9.4	35.2
38	"	2.5	21.7	12.8	14.4	12.2	6.4	30
39	"	1.5	17.7	11.3	13.7	12.5	7.2	36.1
36	Tails 3+4	5.4	30.3	13.4	12.9	9.5	4.8	23.7
37	"	9	25.6	13.3	13.7	10.9	5.5	22
39	"	18	30.5	15	9.8	7.3	3.6	15.8

Cone 1	26-28 microns	Cone 3	15 microns	Cone 5	8 microns
Cone 2	21-22 microns	Cone 4	10 microns		

TABLE 27 - LIME VERSUS SODA ASH IN COPPER ROUGHER CIRCUIT

Zone	Test	CaO or Soda Ash	Copper Rougher Concentrate			
			Weight %	% Cu	% Rec Cu	% Dist Zn
Upper	30	Soda Ash	9.79	2.6	61.2	13.4
	34	CaO	4.92	4.2	51.3	7.4
Lower	31	Soda Ash	10.39	3.1	57.7	13.1
	35	CaO	4.96	5.6	50.4	6.8
High Zn	32	Soda Ash	12.87	2.2	67.7	8.8
	33	CaO	4.31	5.0	55.8	3.7

TABLE 28 - LOCKED CYCLE TEST RESULTS SUMMARY

Zone	Test	COPPER CONCENTRATE Weight %	Assay, % or opt Cu	Zn	Au	Ag	% Distribution Cu	Zn	Au	Ag	Zn CONC Wgt %	% Zn	%Zn Rec	% Zn lost in Zn Clnr Scav Tail	% Zn lost in Scav Tailing
Lower	36	1.6	17.2	2.7	2.4	214	48.8	1.6	3.0	13.7	2.8	50.4	52.7	10.1	35.6
Upper	37	2.1	11.6	3.7	2.2	54.5	58.2	3.6	7.2	6.3	2.5	49.2	55.5	5.4	35.6
High Zn	38	2.9	7.3	8.3	20.2	109	50.8	1.9	14.8	6.3	16.4	53.2	70.0	10.1	18.0
	39	0.8	18.5	7.5	48.3	173	36.5	0.5	10.7	3.0	14.8	57.1	64.5	17.9	17.2
	40	1.7	12.1	8.0	33.6	109	47.9	1.1	14.9	3.8	11.7	54.6	49.2	20.4	29.3
	41	2.0	10.2	7.9	27.7	136	48.6	1.3	14.7	5.9	14.4	57.3	65.2	17.4	16.2
	42	2.2	8.3	10.1	20.9	93	40.7	1.8	12.0	4.2	9.3	54.3	41.8	13.0	43.3
	43	1.1	21.7	6.5			51.3	0.6			8.3	56.3	37.6	25.0	36.8
	44	2.4	11.3	7.9			58.7	1.6			16.6	53.9	74.4	11.9	12.2
	45	3.2	8.6	8.4			62.3	2.2			19.1	54.8	85.0	6.5	6.3

TABLE 29 - PREDICTED METALLURGICAL RESULTS

Product	Zone	Weight %	Assay, % or ppm				% Distribution			
			Cu	Zn	Au	Ag	Cu	Zn	Au	Ag
Feed	Upper	100	0.44	2.31	0.65	19.3				
	Lower	100	0.57	2.88	1.3	28.8				
	High Zn	100	0.43	12.8	3.9	42.5				
Copper Conc	Upper	1.1	20	3	3.0	90	50	1.5	5	5
	Lower	1.4	20	3	2.8	210	50	1.5	3	10
	High Zn	1.1	20	7	40	150	50	0.5	10	3
Zinc Conc	Upper	2.8	0.5	50				60		
	Lower	3.5	0.75	50				60		
	High Zn	20.1	0.25	54				85		

TABLE 30 - CHALCOPYRITE AND SPHALERITE LIBERATION - UPPER TEST 37

Zone	Product	Size Microns	CHALCOPYRITE %	CHALCOPYRITE % Liberation	SPHALERITE %	SPHALERITE % Liberation	% pyrite/ pyrrhotite	Comments
Upper	Cu Conc	+7.5	81.6	99	4.6	95		Visual estimates
		+9.7	65.1	95	1.1	92		Traces liberated covellite/enargite
		+14.1	40.5	90	10.1	88		Locked $CuFeS_2$ <50% particle
		+20.2	35.1	85	9.8	75		Locked ZnS coarse intergrowths as
		+26.0	27.7	78	4.9	55		30-80% particle
		Overall	43.6	90.2	8.3	91.3	46	
	Zn Conc	+8.0		85	95.8	99		Visual estimate
		+10.4		75	91.8	96		Locked $CuFeS_2$ as fine to coarse
		+15.1		50	87.6	90		inclusions in ZnS and pyrite
		+21.6		35	79.2	82		Locked ZnS 25-85% particle
		+27.9		18	75.3	75		
		Overall		41.9	86.8	91.1	11.5	
	Zn Cl Scav TAil	+80		75	1.8	90		Visual estimates
		+10.4		55	1.0	85		Locked $CuFeS_2$ <35% particle
		+15.1		30	0.7	75		Locked ZnS medium to coarse inter-
		+21.7		10	0.5	50		growths with pyrite, $CuFeS_2$ and
		+28.0		5	1.0	25		gangue
		Overall		33.6	0.9	71.1	62	
	Tailing	+8.2		55	0.7	85		Visual estimates
		+10.6		45	0.7	75		Locked $CuFeS_2$ fine intergrowths
		+15.4		30	0.8	65		Locked ZnS as fine to medium inter-
		+22.1		15	0.8	50		growths
		+28.5		5	0.8	35		
		+53		2.5	1.0	15		
		Overall		18.8	0.8	48.2	55	

TABLE 31 - CHALCOPYRITE AND SPHALERITE LIBERATION - LOWER TEST 36

Zone	Product	Size Microns	CHALCOPYRITE %	CHALCOPYRITE % Liberation	SPHALERITE %	SPHALERITE % Liberation	% pyrite/ pyrrhotite	Comments
Lower	Cu Conc	+7.6	79.7	99	5.0	95		Visual estimates Traces liberated covellite/enargite Locked $CuFeS_2$ medium to coarse intergrowths 30-70% particle Locked ZnS fine to coarse intergrowths Some liberated ZnS <5% inclusions of pyrite or $CuFeS_2$
		+9.8	69.2	95	5.0	90		
		+14.3	59.3	85	4.0	85		
		+20.5	50.0	80	5.0	72		
		+26.4	39.9	75	6.9	52		
		Overall	58.3	87.7	5.2	76	35	
	Zn Conc	+8.0		90	95.9	98		Visual estimates Locked $CuFeS_2$ as fine intergrowths and inclusions
		+10.4		85	95.4	95		
		+15.1		78	90.3	85		
		+21.6		65	86.4	80		
		+27.9		48	79.2	73		
		Overall		71.8	90.7	89.4	8	
	Zn Cl Scav Tail	+7.9		5	2.8	90		Visual estimates Locked $CuFeS_2$ as generally large inclusions and intergrowths in pyrite and ZnS
		+10.2		5	2.1	85		
		+14.9		5	1.9	75		
		+21.3		5	2.6	50		
		+27.5		5	3.5	40		
		+53.0		2.5	5.2	20		
		Overall		4.7	2.5	63.3	73	
	Tailing	+7.9		15	0.4	85		Visual estimates Traces liberated covellite/enargite Locked $CuFeS_2$ as fine intergrowths <20% of particle Locked ZnS fine to medium intergrowths
		+10.2		10	1.2	70		
		+14.9		5	1.3	60		
		+21.3		2.5	1.5	55		
		+27.5		2.5	2.1	40		
		+53.0		2.5	3.1	20		
		Overall		3.9	1.7	45.9	80	

TABLE 32 - CHALCOPYRITE AND SPHALERITE LIBERATION - HIGH Zn TEST 38

Zone	Product	Size Microns	CHALCOPYRITE %	CHALCOPYRITE % Liberation	CHALCOPYRITE Intergrowths* 1	2	3	SPHALERITE %	SPHALERITE % Liberation	SPHALERITE Intergrowths* 1	2	3	% pyrite/ pyrrhotite	Comments
High Zn	Cu Conc	+7.4	41.2	67				16.5	21					Microprobe/image analyzer
		+9.5	30.8	66				15.9	27					
		+13.9	23.2	54				15.7	34					
		+19.9	13.4	47				12.7	35					
		+25.6	10.2	29				11.1	40					
		Overall	27.5	61.8	14.0	29.2	56.8	15.0	28.5	12.1	27.0	60.9	51	
	Zn Conc	+8.0		70				98.7	99					Visual estimates
		+10.4		55				98.7	98					Locked $CuFeS_2$ as medium to coarse intergrowths 20-60% of particle
		+15.1		40				97.1	93					
		+21.7		23				95.2	90					
		+28.0		5				91.9	88					Locked ZnS as coarse intergrowths
		+53.0		2				89.0	85					
		Overall		23.9				95.7	92.8				3	
	Zn Cl Scav Tail	+7.9		6.1				13.0	45					Microprobe/image analyzer
		+10.3		21				12.1	69					
		+14.9		13				9.1	59					
		+21.4		2.3				13.3	50					
		+27.6		2.1				24.6	57					
		+53.0		1.8				37.6	67					
		Overall		8.9	80.6	12.7	6.7	15.9	57.5	18.1	30.2	51.7	57	

* locked particles classified into phase % categories as per Petruk([3]), page 25

1 - 0-25% fine intergrowths and inclusions
2 - 25-55% medium intergrowths and inclusions
3 - 55-85% coarse intergrowths and inclusions

TABLE 33 - CHALCOPYRITE AND SPHALERITE LIBERATION - HIGH Zn TEST 39

Zone	Product	CHALCOPYRITE Size Microns	%	% Liberation	Intergrowths* 1	2	3	SPHALERITE %	% Liberation	Intergrowths* 1	2	3	% pyrite/ pyrrhotite	Comments
High Zn	Cu Conc	+7.7	78.0	77				5.3	21					Microprobe/image analyzer
		+10.0	68.7	70				11.4	27					
		+14.6	48.1	59				17.2	34					
		+20.9	41.4	49				18.9	35					
		+27.0	34.6	48				23.2	40					
		Overall	50.4	61.0	9.9	28.2	61.9	16.8	34.5	18.7	34.5	46.8	27	
	Zn Conc	+8.0		90				98.6	99					Visual estimates
		+10.4		75				97.6	97					Locked $CuFeS_2$ as medium
		+15.1		50				95.5	94					intergrowths <50%
		+21.7		35				94.4	90					particle
		+28.0		15				90.9	85					Locked ZnS as coarse
		+53		5				89.0	80					intergrowths
		Overall		35.3				94.9	91.9				3	
	Zn Cl Scav Tails	+7.9		14				25.7	56					Microprobe/image analyzer
		+10.3		15				24.0	62					
		+14.9		11				23.2	68					
		+21.4		3.1				27.5	59					
		+27.6		6				39.9	63					
		+53.0		4.6				50.7	77					
		Overall		11.6	63.8	24.9	11.3	29.7	62.0	12.2	27.2	60.6	47.6	
	Tailings	+7.7		0.5				0.8	3.7					Microprobe/image anlyzer
		+10.0		0				1.0	1.9					
		+14.6		0.2				1.6	4.1					
		+20.9		0.1				2.6	15					
		+26.9		0				7.2	24					
		+53		0.1				15.6	46					
		Overall		0.1	82.2	14.9	2.9	6.6	33.5	29.2	26.8	44.0	68.6	

* as per Table 32

TABLE 34 - HIGH GOLD AND SILVER CONTENT CORE SAMPLES

Diamond Drill Hole	Number	Assay (opt) Au	Ag	RPC Number
51	25916	0.084	3.09	6185CC
	25917	0.092	2.81	6185D
	25917	0.092	2.81	6185E
	25917	0.092	2.81	6185F
	+*25917	0.092	2.81	6185G
	*25918	0.100	3.21	6185H
	*25918	0.100	3.21	6185I
56	*26527	0.104	4.90	6188G
	+*26527	0.104	4.90	6188H
	*26528	0.096	1.71	6188I

* Examined with electron microprobe interfaced with image analyzer

\+ probed with electron microprobe to determine solid solution gold and silver in various phases

TABLE 35 - SILVER MICROPROBE ANALYSES OF VARIOUS MINERALS*

Chalcopyrite	Determination	Sample 6185G	Sample 6188H
Pyrite	1	0	0
	2	0	378
	3	0	170
	4	317	250
Chalcopyrite	1	0	214
	2	166	167
	3	815	154
	4	0	225
	5	0	0
	6		115
	7		281
Sphalerite	1	319	0
	2	0	329
	3	0	414
	4		136
Arsenopyrite	1	0	
	2	279	
	3	247	
	4	0	
	5	623	
Galena	1		0
	2		0
	3		0

* Values below 300 PPM inaccurate but indicate presence of Ag

TABLE 36 - LOW GRADE ORE ECONOMIC ANALYSIS

	Cu	Zn	*Au	*Ag
feed %, ppm	0.48	2.25	0.9	20.9
% recovery	50	60	5	5
% conc grade	20	50		
tonnes conc/tonne ore	.012	.027		
metal recovered/tonne ore	2.4 kg	13.5 kg	0.045 gm	1.045 gm
% payable	95	85	90	90
metal payable/tonne ore	2.28 kg	11.48 kg	0.041 gm	0.941 gm
metal price (Feb 88)	$3.10/kg	$1.30/kg	600/oz $19.3/gm	$8/oz $0.26/gm
charges freight, smelting refining, etc./tonne conc	200	300		
/tonne ore Revenue	$7.07	$14.92		
Charges	2.40	8.10		
Net Smelter Return	$4.67	6.82	0.79	.24

Total NSR = $12.52/tonne ore

* Au, Ag payable in copper concentrate only

TABLE 37 - HIGH GRADE ORE ECONOMIC ANALYSIS

	Cu	Zn	Au	Ag
feed %, ppm	0.43	7.3	2.25	54.7
% recovery	50	80	10	3
% conc grade	20	54		
tonnes conc/tonne ore	.01075	.0181		
metal recovered/tonne ore	2.15 kg	58.4 kg	.225 gm	1.64 gm
% payable	95	85	90	90
metal payable/tonne ore	2.04 kg	49.64 kg	.203 gm	1.48 gm
metal price	$3.10/kg	$1.30/kg	$19.3/gm	$0.26 gm
charges/tonne conc	200	300		
/tonne ore Revenue	6.32	64.53		
Charges	2.15	32.43		
Net Smelter Return	4.17	32.10	3.92	0.38

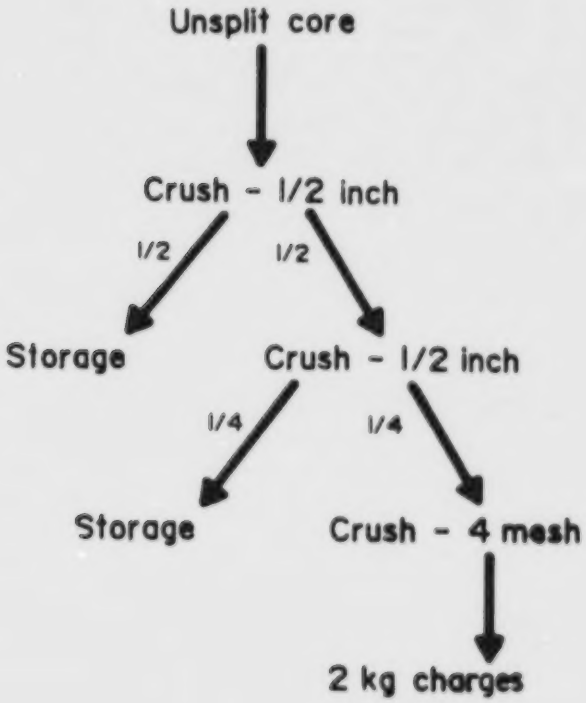
Total NSR = $40.57/tonne

TABLE 38 - HIGH Zn ZONE ECONOMIC ANALYSIS

	Cu	Zn	Au	Ag
feed %, ppm	0.43	12.8	3.9	48.5
% recovery	50	85	10	3
% conc grade	20	54		
tonnes conc/tonne ore	.01075	.2015		
metal recovered/tonne ore	2.15 kg	108.8 kg	.39 gm	1.46 gm
% payable	95	85	90	90
metal payable/tonne ore	2.04 kg	92.48 kg	.351 gm	1.31 gm
metal price	$3.10/kg	$1.30/kg	$19.3/gm	$0.26/gm
charges/tonne conc	200	300		
/tonne ore Revenue	6.32	120.22		
Charges	2.15	60.45		
Net Smelter Return	4.17	59.77	6.77	0.34

Total NSR = $71.05/tonne ore

POINT LEAMINGTON SAMPLE PREPARATION
ALL SECTIONS EXCEPT HIGH Zn



HIGH Zn SECTION

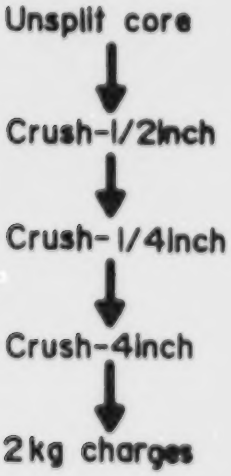


FIGURE 1

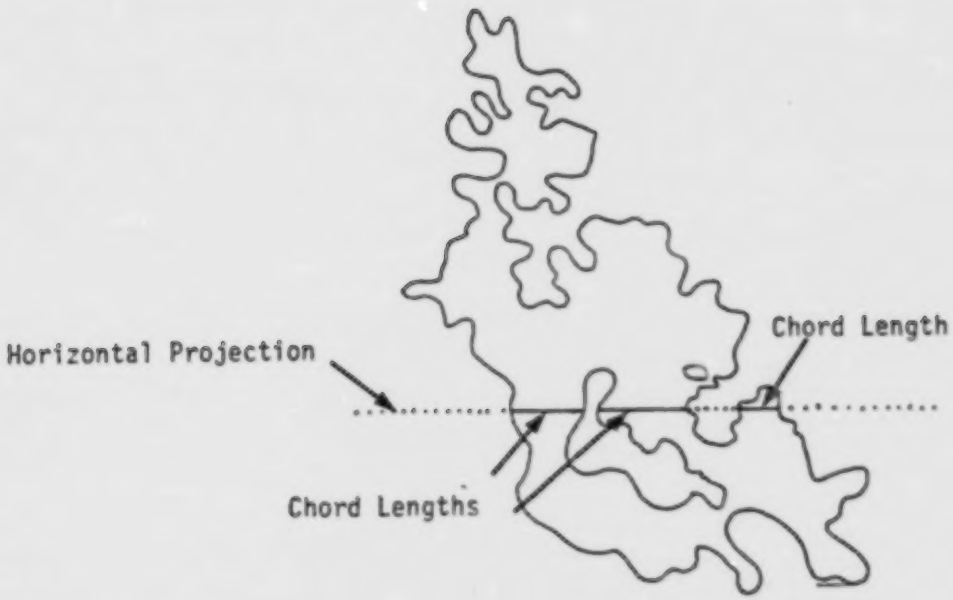


Figure 2. Chord Measurements. A chord measurement is the length of a line which intersects the phase of interest along a horizontal projection. Several chord measurements may be collected along one projection as seen in the diagram above. The "chord lengths" are collected along evenly spaced horizontal projections 25 micron apart.

FROM : RPC REPORT MDP/87/02

FLOWSHEET TESTS 18-25
VARY PRIMARY GRIND

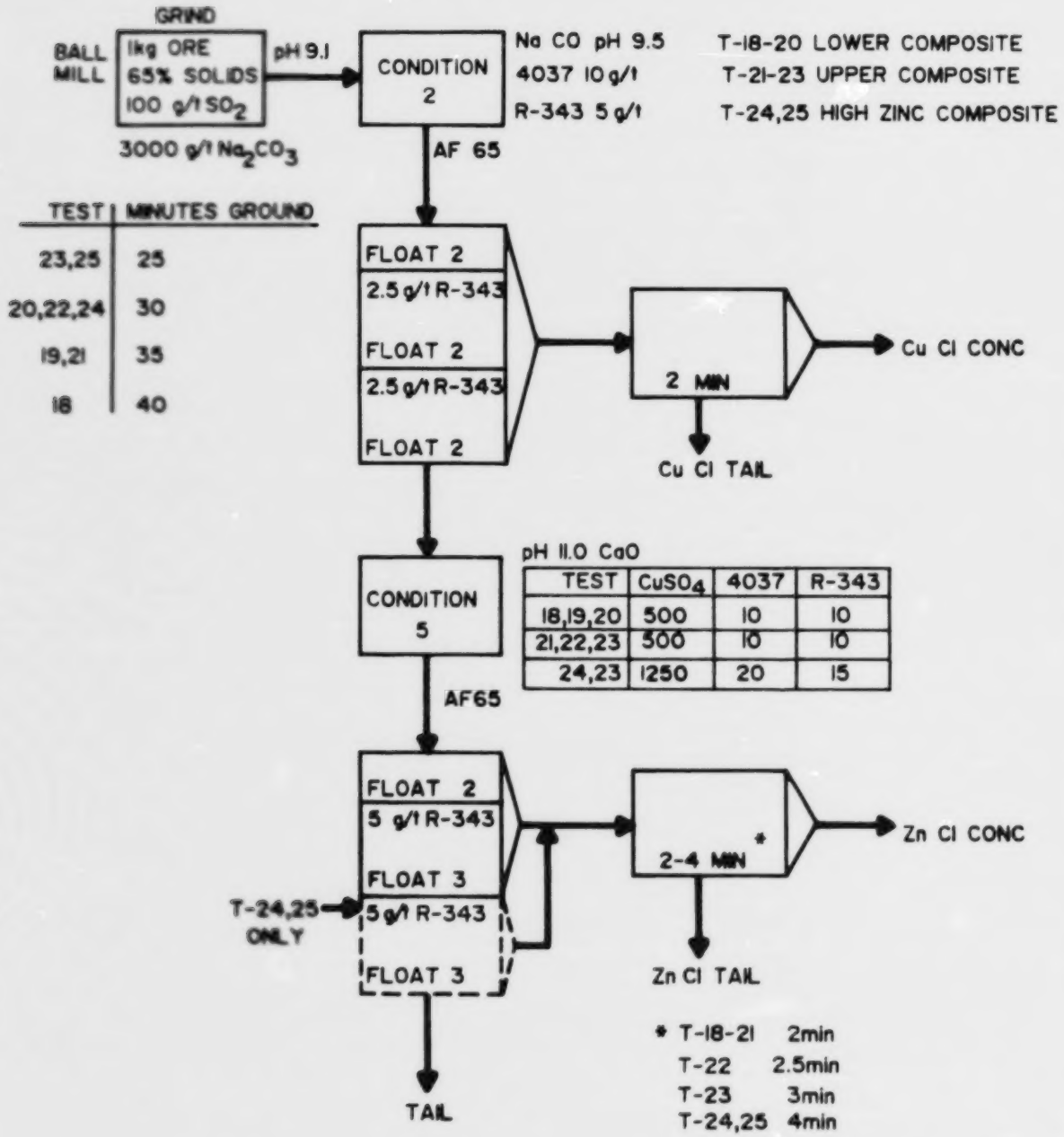


FIGURE 3

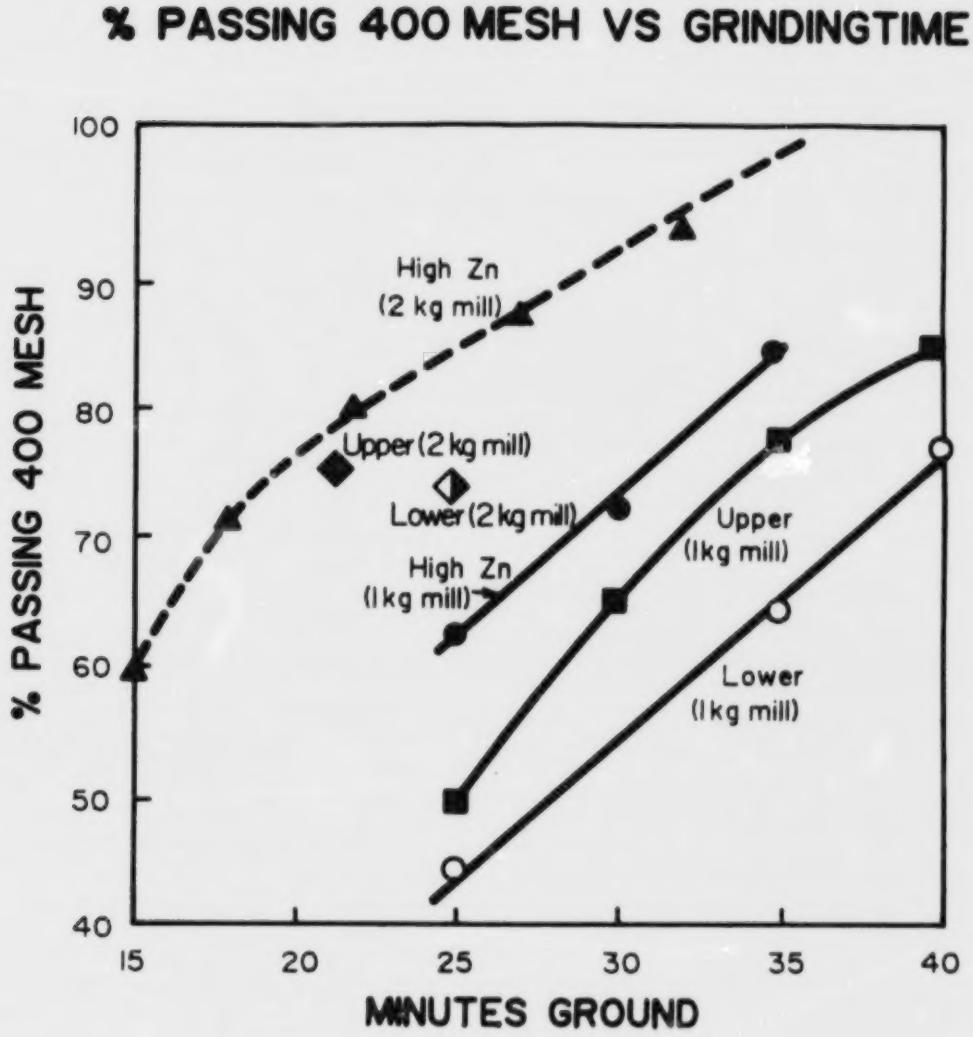

% PASSING 400 MESH VS GRINDINGTIME
% PASSING 400 MESH
100
90
80
70
60
50
40
15
20
25
30
35
40
MINUTES GROUND
High Zn
(2 kg mill)
Upper (2 kg mill)
Lower (2 kg mill)
High Zn
(1 kg mill)
Upper
(1 kg mill)
Lower
(1 kg mill)

FIGURE 4

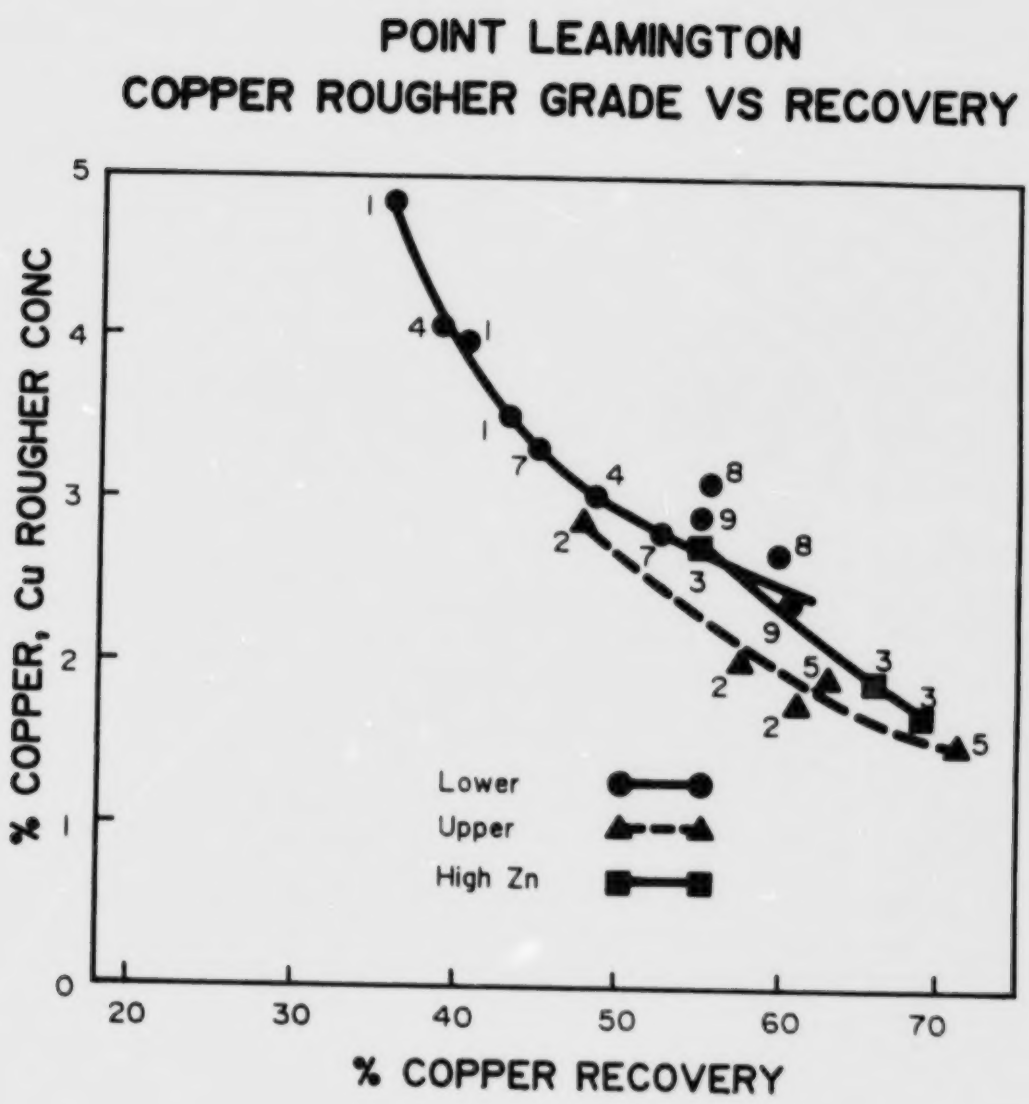

POINT LEAMINGTON
COPPER ROUGHER GRADE VS RECOVERY
% COPPER, Cu ROUGHER CONC
% COPPER RECOVERY
0
1
2
3
4
5
20
30
40
50
60
70
Lower
Upper
High Zn

FIGURE 5

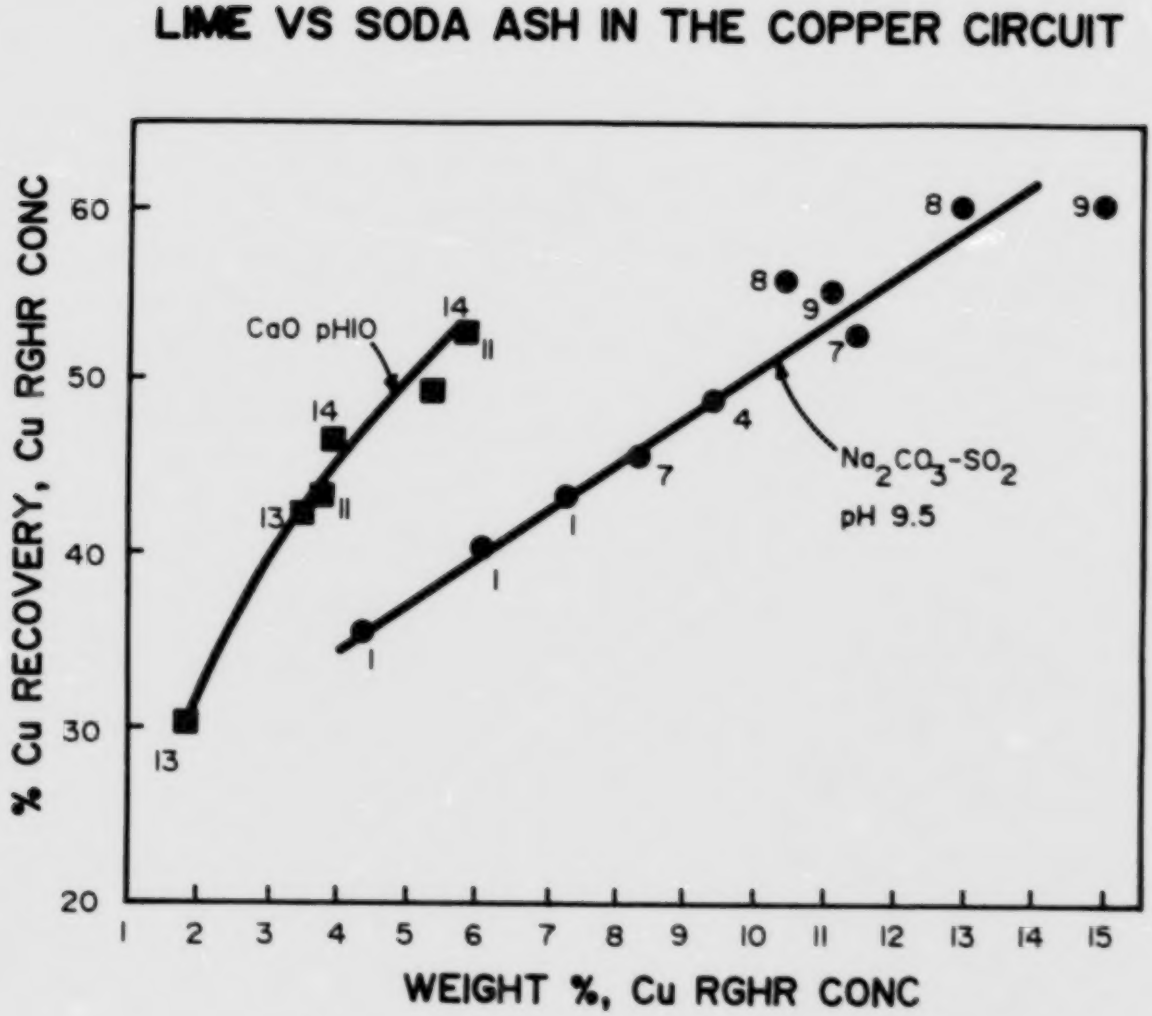

LIME VS SODA ASH IN THE COPPER CIRCUIT
% Cu RECOVERY, Cu RGHR CONC
WEIGHT %, Cu RGHR CONC
CaO pH10
Na_2CO_3-SO_2
pH 9.5
20
30
40
50
60
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

FIGURE 6

STANDARD LOCKED CYCLE TEST FLOWSHEET

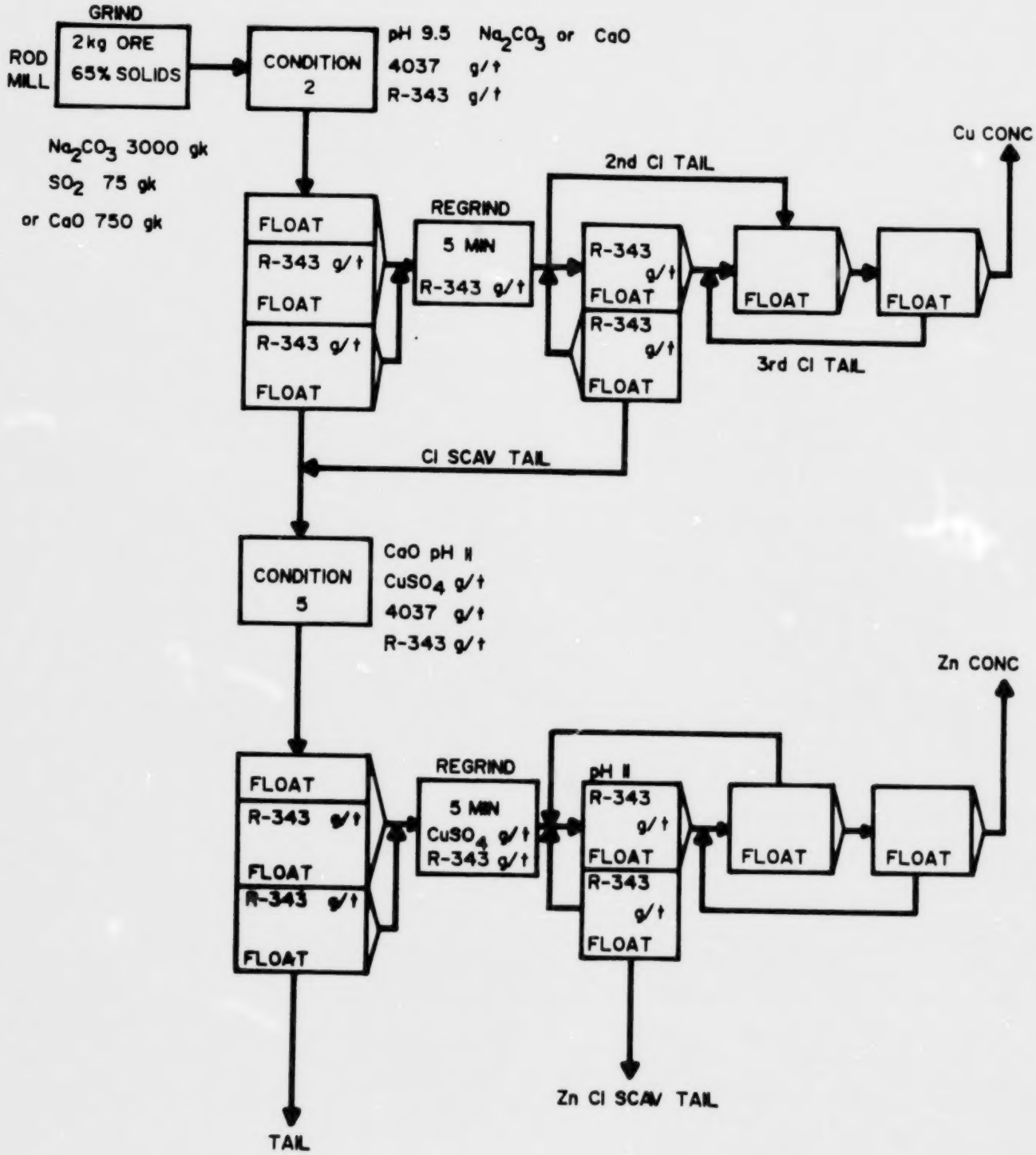


FIGURE 7

Cu RECOVERY VS
COPPER CONCENTRATE GRADE

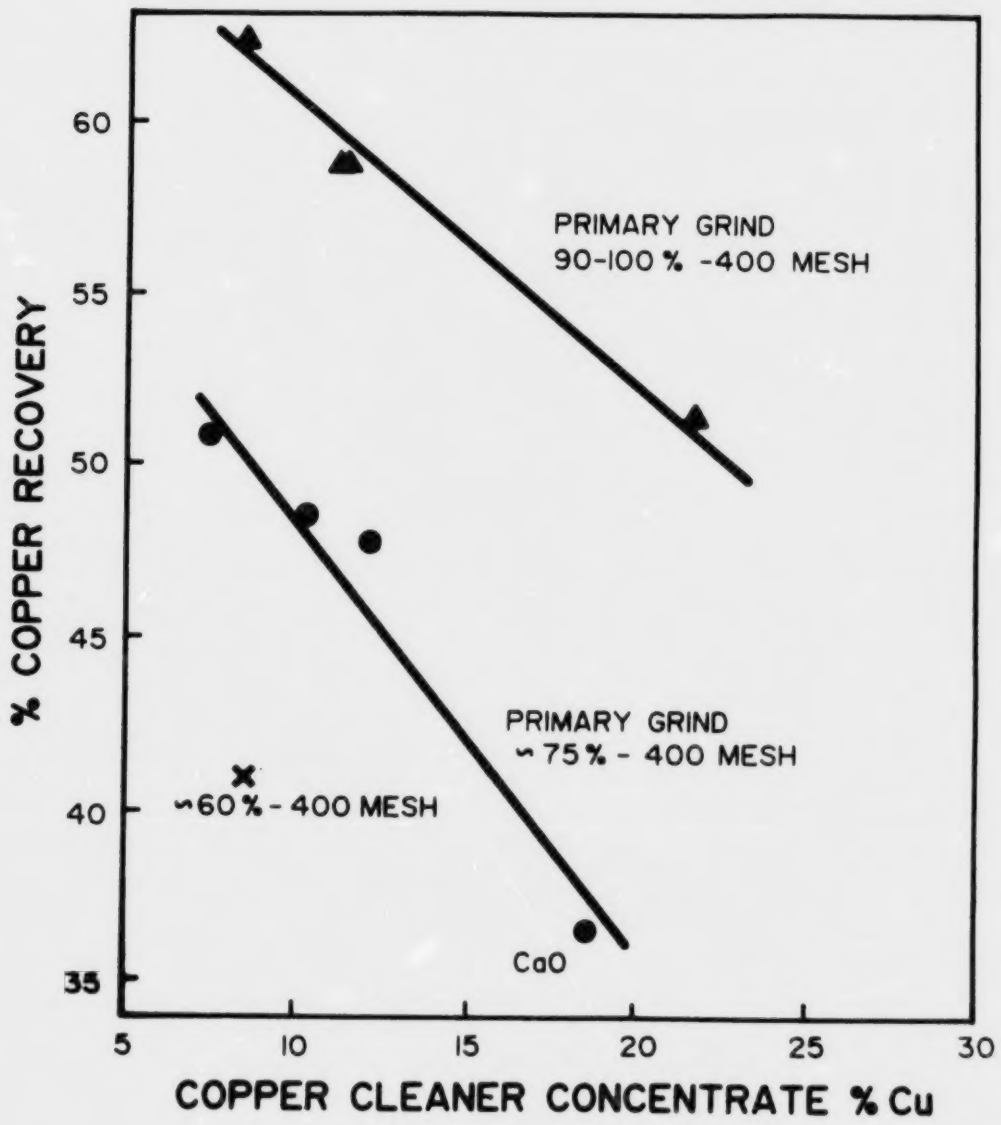


FIGURE 8

APPENDIX I

NORANDA RESEARCH CENTRE

SOLICITED PROPOSAL TO DSS

CENTRE DE RECHERCHE NORANDA

SOLICITED PROPOSAL

TO

DEPARTMENT OF SUPPLY AND SERVICES CANADA

EVALUATION OF THE POINT LEAMINGTON DEPOSIT

PHASE II

(DSS File No. 06SQ.23440-5-9210)

JULY 1986

REVISED : 2 SEPTEMBER 1986

REVISION #2 : 15 SEPTEMBER 1986

Prepared by:
K.G. Stowe, Program Manager,
Mineral Processing

Submitted by: Noranda Inc.

Noranda Research Centre
240 Hymus Boulevard
Pointe Claire, Quebec H9R 1G5

Authorized by:
P. Tarassoff, Director
Research & Development

1. SUMMARY

A revised request for proposal (RFP) entitled "Evaluation of the Point Leamington Deposit, Phase II" (DSS File No. 06SQ.23440-5-9210) was received from the Department of Supply and Services Canada. The statement of work for the RFP is given in Appendix I and involves bench scale testing, mineralogical analyses, and economic assessment of three bulk samples: upper lower grade, lower low grade and Zn rich.

The metallurgical testing and economic assessment will be carried out by the Noranda Research Centre, a division of Noranda Inc. The Noranda Research Centre shall be the main contractor and the Project Manager. The mineralogical studies will be performed by the New Brunswick Research and Productivity Council (RPC) who shall be a sub-contractor to Noranda Research.

The ores of the Leamington deposits are variable, low grade and extremely fine grained. Metallurgical bench batch scale tests shall be performed in order to develop possible processing methods. Mineralogical analyses will be performed on the ore, and test products, both tails and concentrates, in order to determine the mineralogical distribution of the elements and the grain size and liberation of the minerals. This information in conjunction with assay results will be used to optimize batch tests. The results of the optimized batch and and mineralogy will be used to develop a proposed processing scheme and preliminary economic assessment.

The work will require an estimated 15 months for completion at a cost of $159,815.

2. INTRODUCTION

The Point Leamington Deposit is a large low grade Cu, Zn, Au and Ag sulphide deposit. Noranda Inc. currently has the right to the deposit, and between 1971-75 carried out extensive metallurgical testing. The average grade of the deposit is approximately 0.56 wt% Cu and 2 wt% Zn with variable amounts of gold and silver (DSS telex 29/11/85). Noranda, which has had extensive experience with fine-grained sulphide deposits (Brunswick Mining and Smelting, Heath Steele and Geco) was unable to produce a profitable concentrate. The best results were a 15% Cu concentrate and a 50% Zn concentrate at 75% Cu and 65% Zn recoveries, respectively. The gold recovery was less than 10% and silver approximately 10%. Also, an arsenopyrite concentrate was prepared in the hope that the gold would concentrate with arsenopyrite. Gold and silver did not preferentially concentrate with any of the concentrates. A cyanide leach of the flotation tailings for gold was tried without success.

The poor recoveries were attributed to the fine-grained nature of the ore. For example, the Cu loss was attributed to the fineness of chalcopyrite inclusions (3-10 microns) in pyrite. The poor Au and Ag recoveries were probably due to the same problem, however

the minerals that contained the Au and Ag were not positively identified.

In this study, the results and recommendations of the previous work will first be reviewed. In light of recent improvements in process technology and advances in mineralogical techniques, new approaches to the mineral processing of this ore will be investigated.

3. OBJECTIVES

Approximately 1.5 tons of unsplit core from four drill holes has been identified for mineralogical and metallurgical testing. The ore has been classified into 8 ore sections which will be assayed prior to preparing larger bulk samples. Three bulk samples are presently contemplated including an upper low-grade zone, lower low-grade zone and high-grade Zn zone. Since the high-grade Zn zone was intersected in only one hole, only a relatively small amount of material is available. The various ore types will be characterized chemically and mineralogically. The mineralogy of the economic minerals shall be determined. Batch testing shall be performed in order to evaluate the feasibility of producing marketable concentrates. Due to the very fine grained nature of the minerals, liberation studies will be an important component of the test program.

Product and test evaluation shall be made by chemical analyses and by state-of-the-art, quantitative mineralogical techniques. In particular, automatic image analyses and interfaced microprobe analyses shall be used to determine mineral modes and mass balances, grain size, and degrees of liberation of the minerals. Also, the distribution of the elements among the mineral phases shall be determined. It is of particular importance to determine the minerals which carry the gold and silver. State-of-the-art grinding, size classification and flotation methods with regard to fine-grained ores shall be investigated.

4. SCOPE

Task 1. Megascopic, Microscopic and Chemical Characteristics of the Ore

Sixty-one boxes of drill core will be shipped to the Noranda Research Centre. Eight section samples will be crushed, prepared and assayed. Based on present information, three larger bulk samples will be prepared from the sections for bench scale testing. In collaboration with RPC personnel, samples from the eight sections and three bulk samples will be selected for mineralogical study to characterize the orebody. Since this characterization is not the main thrust of the project, it will be investigated in a very reconnaisance-type approach.

Approximately 20 samples shall be selected from the uncrushed core and section and bulk samples. Polished sections and unpolished thin sections shall be prepared for examination. The

section and bulk samples shall be chemically analyzed for major and trace elements (SiO_2, Al_2O_3, TiO_2, Fe_2O_3, FeO, P_2O_5, K_2O, Na_2O, CaO, MgO, MnO, L.O.I., R_2O_3, Sr, Cu, Pb, Zn, Bi, As, S, Au, Ag, Sb).

The polished sections and unpolished thin sections shall be examined microscopically (texture and grain size) and the mineral phases shall be analyzed by microprobe.

Task 2. Preliminary Batch Tests and Mineralogy of Products

Preliminary batch tests will include flotation tests at different grinds and different reagent and flotation conditions. Selected heads and products of the tests will be cyclosized, assayed, and mineralogically analyzed. The mineralogical investigation will include automated image analysis (AIA) for grain size, liberation and mineral modes. The mineralogy will be performed at RPC. The results of this task will be used to set the conditions for a second batch of flotation tests which will be used to optimize these conditions.

Task 3. Extensive Batch Test

The results of Task 2 will be used to set limiting conditions on the batch tests. Variables such as fineness of grind, reagents and flotation conditions will be optimized to produce the best products at the highest recoveries. Selected products will be mineralogically analyzed as in Task 2.

Task 4. Preliminary Economic Assessment

The results of the batch and locked cycle tests shall be used for a preliminary economic assessment. The economic assessment will include estimates of mining and milling costs.

Task 5. Reporting and Presentation

A report will be prepared on the above tasks. The results will be discussed by the Province, the deposit owner, Mineral Services Labs, CANMET and the Mineral Policy Section of EMR. This report will recommend the feasibility of a pilot study. If the recommendation is positive, then the details of a proposed pilot study will be given.

5. EXPECTED BENEFIT

The main goal of this project is the application of new technology to the beneficiation of a fine-grained low grade massive sulphide ore deposit. The new technologies being applied are of two types: new and improved processing methods, and new analytical methods.

Advances in process technologies include improved grinding and flotation practices for fine grained materials.

6. PRICE PROPOSAL

The work will require an estimated 15 months for completion at a cost of $159,815.

TABLE I

NORANDA RESEARCH CENTRE

Labour and Overheads	42,092.
Analytical	22,000.
Profit (7.0% of above)	4,420.
Supplies, shipping core	7,000.
Travel and Living	600.
Sub Contract RPC as detailed in Appendix III	83,703.
TOTAL COST	159,815.

6.1 Labour

Billing rates for Noranda Research Centre personnel will be in accordance with the following formula:

$$\text{Hourly Rate} = \frac{\text{Annual Salary (\$)} \times 2.55}{1885}$$

The assigned personnel and labour are:

		h	$/h	$
K.G. Stowe	Project Manager	175	$79.81	13,967.00
J.Y. Kim	Metallurgist	50	$53.43	2,672.00
A.A. Condy	Economist	50	$60.87	3,043.00
S. Lajoie	Technologist	500	$34.83	17,410.00

Additional Noranda Research and corporate personnel will be requested to consult in specific areas of expertise as required. Such costs will be charged in accordance with the previous formula, and are estimated at $5,000.

6.2 Analytical

Analytical charges have been estimated at $22,000 (2200 determinations at $10).

6.3 Equipment, Materials and Supplies

All items will be billed at cost without mark-up.

Reagents for flotation and laboratory supplies are estimated at $5,000.

6.4 Travel and Living

Costs will be in accordance with Noranda Research guidelines and will be billed at cost with no mark-up.

CANMET, Ottawa	3 trips x $200/trip	$600.00

6.5 Sub-Contract

The mineralogical services required in the contract will be supplied by the New Brunswick Research and Productivity Council as per their proposal to Noranda Research Centre, Appendix II.

6.6 Anti-inflation Policy

In keeping with the government's anti-inflation policy, salary increases are limited to no more than 3% in the 12 month period commencing September 1 1985.

6.7 Price Certification

We hereby certify the price quoted is based on costs computed in accordance with Costing Memorandum DSS 1031 (9/70), a copy of which we acknowledge to have received and that the said price contains an estimated amount of profit of 7.0 0% of labour and overhead and analytical.

7. MANAGEMENT PROPOSAL

7.1 Staff and Facilities

The staff and facilities of Noranda Research Centre will be used in the program. Mr. K.G. Stowe will act as Project Manager. Mr. J.Y. Kim will assist in the development and conducting of the flotation program (resumes - Appendix IV).

The Noranda Research Centre has comprehensive sample preparation, laboratory flotation and laboratory leaching equipment for use in the program. The analytical laboratories are well equipped for metal analyses.

The Noranda group has extensive experience in processing fine-grained complex sulphide ores. Over the past year and a half,

Noranda Research personnel have extensively participated in pilot plant testing of modifications to the Brunswick Mining concentrator flowsheet. These modifications are presently being implemented with significant cost savings and metal recovery improvements being expected. Research Centre personnel are presently carrying out electrochemical (E_h) studies at several Noranda Group concentrators (Mattabi, Geco, Brunswick) treating complex sulphide ores. Interaction between operating and research personnel is actively promoted to ensure the best possible technology and information transfer. In addition, the Research Centre houses experts in almost all areas of copper and zinc processing (smelting, refining, hydrometallurgy, etc.). Also, it should not be forgotten that Noranda has done considerable testing on a variety of samples from the Point Leamington deposits. This experience is valuable in that resources will not be wasted on repeating previous work.

The Research and Productivity Council has an experienced staff of mineralogists and metallurgists and has a state-of-the-art microprobe (delivery by May 1, 1986 or earlier) and automated image analysis which will be fully interfaced with the microprobe. RPC has had the AIA system for over a year and in the past RPC staff have used the system at CANMET.

D.S. Chyrssoulis has developed a method for the micro-trace analyses of Ag and Au using a secondary ion mass spectrometry. This technique was developed in order to better determine mineral and element mass balances for Ag during the processing of a massive sulphide ore. RPC has completed many projects concerning the mineraology and mineral processing of Bathurst masive sulphide deposits. This work lead to the development of the SRL process and to the establishment of a demonstration plant at Chatham, N.B. This plan is operating by ERS, Enhanced Recovery System, an RPC subsidiary. RPC staff are involved in the daily operation of the plant and other staff members are involved in the testing of the products (chemical analysis, mineralogy, XRD and AIA).

The project proposed from the Leamington Deposit is similar to others undertaken by Noranda Reserach Centre and the Research and Productivity Council. The experience and facilities available by this team is essential for a project of this scope.

7.2 Program Schedule

A work plan for the project is given in Appendix III. The plan is 15 months after the availability of the samples.

7.3 Reporting

Review meetings will be held with the Scientific Authority following the completion of Task 2, Task 3, and Task 5. A draft report will be issued for review; the final report, incorporating any recommendations of the client, will be issued subsequently.

8. CONTRACT PROVISIONS

8.1 An estimate is established of the cost for the project. Noranda Research Centre will not incur costs that exceed this estimate without first obtaining the approval of the Client.

8.2 Noranda Research Centre will only charge for costs that have been incurred. Invoices are issued monthly.

8.3 Ownership of inventions and technology arising from work carried out in the performance of the contract will be governed by the conditions set forth in General Conditions Research and Development, DSS 9224.

APPENDIX III

WORK PLAN

DETAILS OF COSTS

		Noranda	RPC	Project Total
Task 1	Labour	5,000	11,535	22,025
	Analyses	2,000		
	Profit	490		
	Supplies	1,000		
	Shipping	2,000		
	Total	10,490	11,535	22,025
Task 2	Labour	6,807		
	Analyses	8,000		
	Profit	1,036		
	Supplies	2,000		
	Travel	200		
	Total	18,043	20,162	38,205
Task 3	Labour	12,000		
	Analyses	12,000		
	Profit	1,680		
	Supplies	2,000		
	Travel	200		
	Total	27,880	55,706	83,586
Task 4	Labour	5,544		
	Profit	363		
	Total	5,907	3,348	9,255
Task 5	Labour	12,741		
	Profit	851		
	Travel	200		
	Total	13,792	7,653	21,445
Total Tasks 1-5		76,112	83,703	159,815

Supply and Services Canada / Approvisionnements et Services Canada

DSS MAS 0143 3 (4/81)

CONTRACT PLAN AND REPORT FORM – FORMULE DE PROJET DE CONTRAT ET DE RAPPORT

CONTRACT TITLE – TITRE DU CONTRAT: EVALUATION OF THE POINT LEAMINGTON DEPOSIT – PHASE II

CONTRACTOR – ENTREPRENEUR

FILE NO. – N° DU DOSSIER: 06SQ.23440-5-9120

SERIAL NO. – N° DE SÉRIE:

YEAR 1

TASK DESCRIPTION / DESCRIPTION DE LA TÂCHE	TASK DURATION IN MONTHS – DURÉE DE LA TÂCHE EN MOIS 1	2	3	4	5	6	7	8	9	10	11	12	TASK COST – COÛT DE LA TÂCHE: PLANNED PRÉVU À L'ORIGINE	ACTUAL PRÉSENTEMENT	E.T.C. À VENIR
Task 1 Sample preparation	■												10,490		
Mineralogy (RPC)	■	■	■	■									11,535		
Task 2 Prelim.tests,cyclosizing			■	■	■								18,043		
Mineralogy (RPC)					■	■	■	■					20,162		
Task 3 Optimization test							■	■	■	■	■		27,880		
Mineralogy (RPC)										■	■		27,337		
Task 4 Economics analysis											■	■	4,628		
Task 5 Report & Presentation													0		
PLANNED COST BY MONTH / COÛT PRÉVU POUR CHAQUE MOIS	12,413	3,845	7,453	9,140	7,217	6,721	6,721	13,690	6,970	6,970	20,639	18,296	PLAN 120,075	ACTUAL COÛTS RÉELS	E.T.C. À VENIR
ACT. PRÉSENT. / E.T.C. BY MONTH PRÉVISION POUR CH. MOIS															

Supply and Services Canada | Approvisionnements et Services Canada

DSS MAS 9143 3 (4/8)

CONTRACT PLAN AND REPORT FORM – FORMULE DE PROJET DE CONTRAT ET DE RAPPORT

CONTRACT TITLE – TITRE DU CONTRAT: EVALUATION OF THE POINT LEAMINGTON DEPOSIT – PHASE II

CONTRACTOR – ENTREPRENEUR

YEAR 2

FILE NO. – N° DU DOSSIER: 06SQ.23440-5-9120

SERIAL NO. – N° DE SÉRIE:

TASK DESCRIPTION / DESCRIPTION DE LA TÂCHE	TASK DURATION IN MONTHS – DURÉE DE LA TÂCHE EN MOIS 1	2	3	4	5	6	7	8	9	10	11	12	TASK COST – COÛT DE LA TÂCHE: PLANNED / PRÉVU À L'ORIGINE	ACTUAL / PRÉSENTEMENT	E.T.C. / À VENIR
Task 1 Sample preparation													Ø		
Mineralogy (RPC)													Ø		
Task 2 Prelim.tests,cyclosizing													Ø		
Mineralogy (RPC)													Ø		
Task 3 Optimization tests													13,668		
Mineralogy (RPC)													4,627		
Task 4 Economic Analysis													21,445		
Task 5 Report & Presentation															
PLANNED COST BY MONTH / COÛT PRÉVU POUR CHAQUE MOIS	18,295	10,723	10,722										PLAN 39,740	ACTUAL COÛTS RÉELS	E.T.C. À VENIR
ACT. PRÉSEN. / E.T.C. BY MONTH PRÉVISION POUR CH. MOIS															

APPENDIX II

PRELIMINARY BENCH TESTS

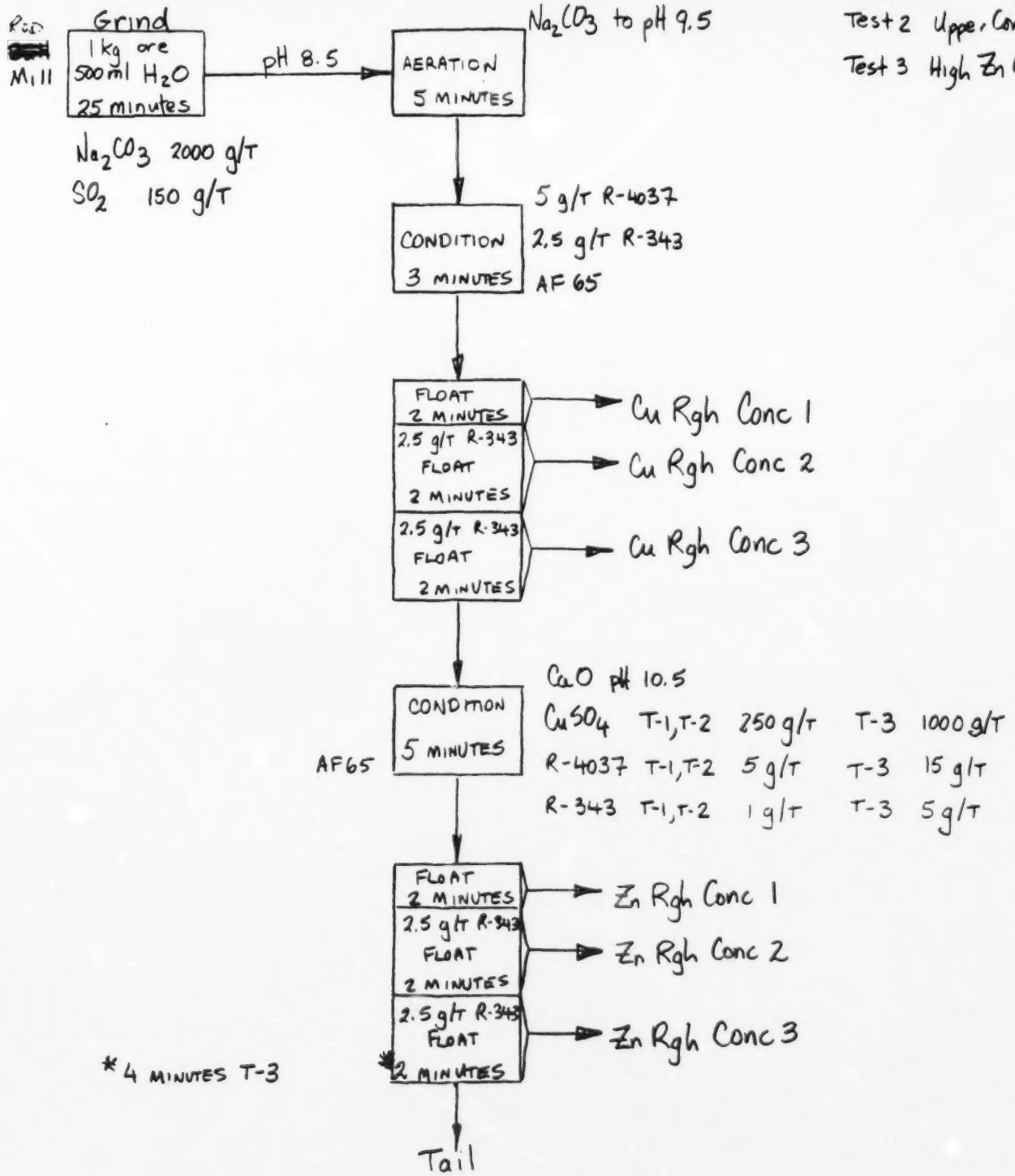
DETAILED PROCEDURES AND RESULTS

Tests 1-3

17 Dec/86

PURPOSE: Exploratory

Test 1 Lower Comp
Test 2 Upper Comp
Test 3 High Zn Comp



POINT LEAMINGTON DEPOSIT TEST NUMBER 1

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	PB	AG	CU	ZN	PB	AG
LOWER	CU RGH CONC 1	45.3	4.44	4.83	3.84	.31	80.9	35.53	5.54	9.99	6.73
	CU RGH CONC 2	17.2	1.69	1.7	4.89	.19	56.6	4.75	2.68	2.32	1.79
	CU RGH CONC 3	13.3	1.30	1.2	5.71	.16	52.5	2.59	2.42	1.51	1.28
	ZN RGH CONC 1	46.5	4.56	.5	28.3	.1	41.7	3.78	41.94	3.31	3.56
	ZN RGH CONC 2	18.4	1.80	.56	12.9	.12	51.6	1.67	7.56	1.57	1.74
	ZN RGH CONC 3	8.2	.80	.57	6.96	.13	41.8	.76	1.82	.76	.63
	TAIL	871.1	85.40	.36	1.37	.13	52.7	50.92	38.03	80.54	84.27
	HEAD	1020	100.00	.60	3.08	.14	53.41	100	100	100	100

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 21	+200MESH	0	0	0	0	.00	.00	.00
UPPER COMP	+270MESH	8.8	.21	.68	.69	14.05	14.24	9.35
TAIL	+35.3mic	18.9	.2	.54	.84	28.74	24.29	24.45
	+27.3	13.5	.16	.43	.68	16.42	13.81	14.14
	+19.1	17.1	.09	.3	.52	11.70	12.21	13.69
	+13.1	11.3	.08	.2	.5	6.87	5.38	8.70
	+10.1	5.9	.08	.19	.55	3.59	2.67	5.00
	-10.1	24.5	.1	.47	.654	18.63	27.40	24.67
CALC	HEAD	100	.13	.42	.65	100	100	100
ASSAY	HEAD		.15	.46	.72			

POINT LEAMINGTON DEPOSIT TEST NUMBER 2

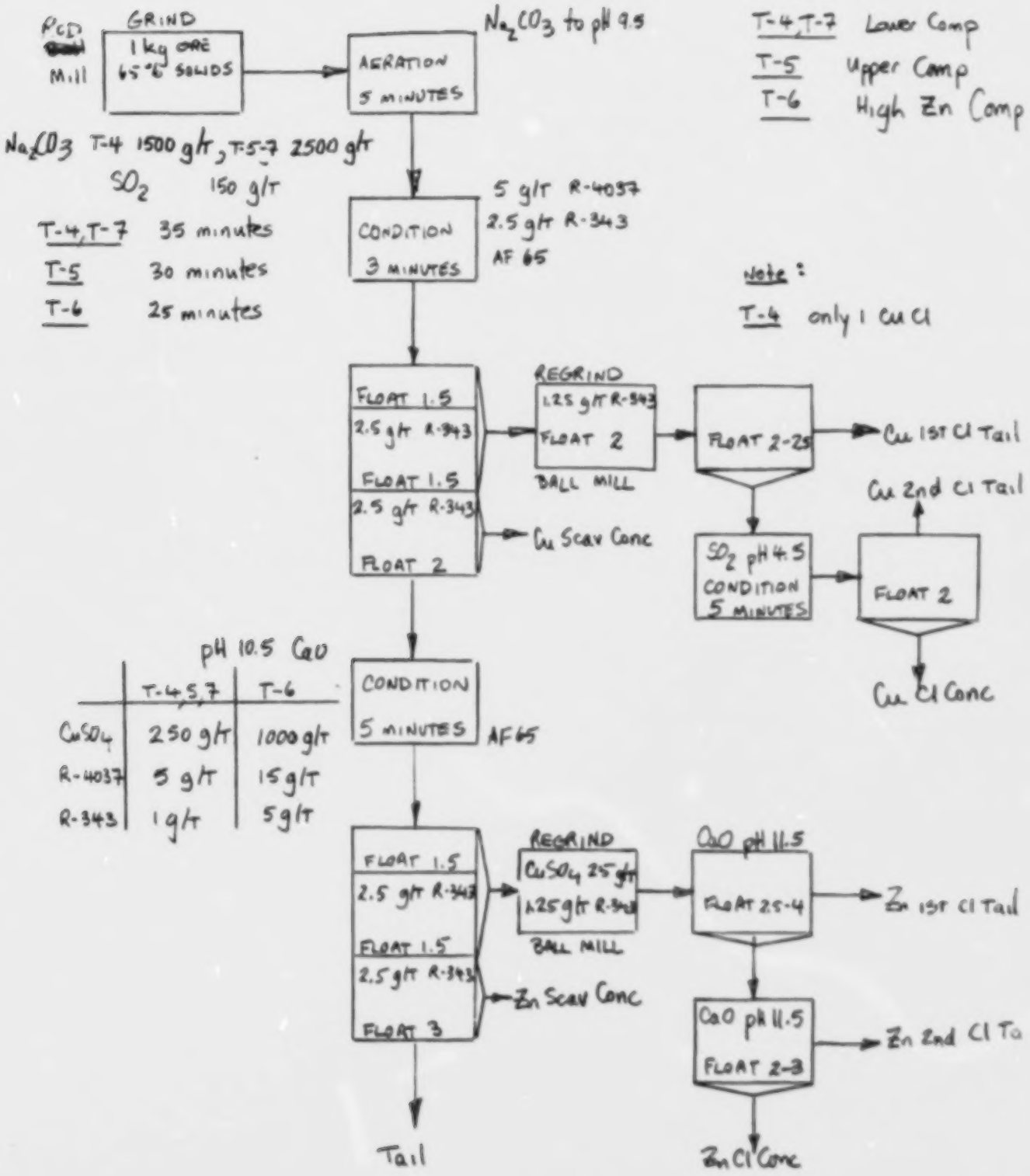
OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	PB	AG	CU	ZN	PB	AG
OWER	CU RGH CONC 1	78.7	7.84	2.83	2.35	.38	36.3	47.73	7.79	20.73	9.48
	CU RGH CONC 2	55.2	5.50	.83	2.46	.18	39.8	9.82	5.72	6.89	7.29
	CU RGH CONC 3	27.5	2.74	.59	2.77	.15	33.8	3.48	3.21	2.86	3.08
	ZN RGH CONC 1	39.3	3.92	.34	25.9	.1	44.1	2.86	42.85	2.72	5.75
	ZN RGH CONC 2	25.5	2.54	.34	11.3	.12	36	1.86	12.13	2.12	3.05
	ZN RGH CONC 3	33.2	3.31	.33	4.78	.12	46.8	2.35	6.68	2.76	5.16
	TAIL	744.3	74.16	.2	.69	.12	26.8	31.90	21.62	61.91	66.19
	HEAD	1003.7	100.00	.46	2.33	.14		100	100	100	100

,T LEAMINGTON DEPOSIT TEST NUMBER 3

MPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	PB	AG	CU	ZN	PB	AG
IIGH ZN	CU RGH CONC 1	91.7	9.01	2.74	8.21	1.37	82.3	68.48	5.33	34.30	11.37
	CU RGH CONC 2	67.9	6.68	.71	10.8	.59	65.1	13.14	5.19	10.94	6.66
	CU RGH CONC 3	26.4	2.60	.5	12.7	.41	83	3.60	2.37	2.96	3.30
		0	.00	0	0			.00	.00	.00	.00
	ZN RGH CONC !	66.6	6.55	.19	49.1	.22	83.7	3.45	23.15	4.00	8.40
	ZN RGH CONC 2	87.4	8.59	.18	51.3	.18	57.5	4.29	31.74	4.30	7.57
	ZN RGH CONC 3	70.1	6.89	.19	39.7	.24	77.3	3.63	19.70	4.59	8.16
	ZN RGH CONC 4	32.1	3.16	.23	23.9	.32	98.5	2.01	5.43	2.80	4.76
	TAIL	575	56.53	.16	1.74	.23	57.5	1.40	7.08	36.11	49.79
	HEAD	1017.2	100.00	.36	13.89	.36	65.28	100	100	100	100

Tests 4-7

22 January /87



DINT LEAMINGTON DEPOSIT TEST NUMBER 4

MPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
WER	CU CL CONC	12.3	1.23	14	2.24	0	181	28.95	.98	.00	8.84
	CU CL TAIL	45.2	4.52	1.34	2.72	0	26.1	10.18	4.37	.00	4.69
	CU SCAV CONC	37.7	3.77	1.47	3.54	0	30.9	9.32	4.75	.00	4.63
		0	.00	0	0			.00	.00	.00	.00
	ZN CL CONC	8.2	.82	1.35	51.5	0	41.1	1.86	15.02	.00	1.34
	ZN 2 CL TAIL	4.1	.41	1.39	12.9	0	36	.96	1.88	.00	.59
	ZN 1 CL TAIL	32.9	3.29	.62	4	0	28.1	3.43	4.68	.00	3.67
	ZN SCAV CONC	30.4	3.04	.68	12.7	0	33.9	3.48	13.73	.00	4.09
	TAIL	829.4	82.92	.3	1.85	.00	21.9	41.83	54.58	.00	72.15
	HEAD	1000.2	100.00	.59	2.81	.00	25.17	100	100	100	100

POINT LEAMINGTON DEPOSIT TEST NUMBER 5

OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
UPPER	CU CL CONC	56.5	5.69	4.28	2	1.27	30.9	54.98	4.91	10.95	8.73
	CU 2 CL TAIL	19.4	1.95	.43	1.65	.75	25	1.90	1.39	2.22	2.43
	CU 1 CL TAIL	70.4	7.09	.35	2.19	.65	23	5.60	6.70	6.98	8.10
	CU SCAV CONC	69.1	6.96	.54	2.44	.72	25	8.48	7.32	7.59	8.64
	ZN CL CONC	25.1	2.53	.38	44.7	.58	33.9	2.17	48.74	2.22	4.26
	ZN 2 CL TAIL	6.8	.68	.4	5.96	.72	24	.62	1.76	.75	.82
	ZN 1 CL TAIL	44.8	4.51	.25	2.09	.93	28.1	2.55	4.07	6.36	6.30
	ZN SCAV CONC	40.7	4.10	.29	4.47	.72	20.9	2.68	7.90	4.47	4.25
	TAIL	660.5	66.50	.14	.6	.58	17.1	21.02	17.21	58.46	56.48
	HEAD	993.3	100.00	.44	2.32	.66	20.13	100	100	100	100

POINT LEAMINGTON DEPOSIT TEST NUMBER 6

OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	46.3	4.64	4.3	8.72	12.2	71	49.22	2.91	14.34	6.66
	CU 2 CL TAIL	26.3	2.63	.66	8.64	5.28	55.9	4.29	1.64	3.53	2.98
	CU 1 CL TAIL	86	8.61	.45	10.6	4.01	51.8	9.57	6.57	8.76	9.02
	CU SCAV CONC	55.4	5.55	.48	12.7	4.05	53.8	6.57	5.07	5.70	6.04
	ZN CL CONC	157.1	15.73	.15	55.3	2.09	42.9	5.83	62.59	8.34	13.65
	ZN 2 CL TAIL	6.5	.65	.27	21.2	5.14	77.1	.43	.99	.85	1.02
	ZN 1 CL TAIL	36.1	3.62	.21	13.8	4.29	76.1	1.87	3.59	3.93	5.56
	ZN SCAV CONC	42.3	4.24	.2	27.8	4.25	66.9	2.09	8.47	4.56	5.73
	TAIL	542.6	54.34	.15	2.09	3.63	44.9	20.12	8.17	50.00	49.34
	HEAD	998.6	100.00	.41	13.90	3.94	49.44	100	100	100	100

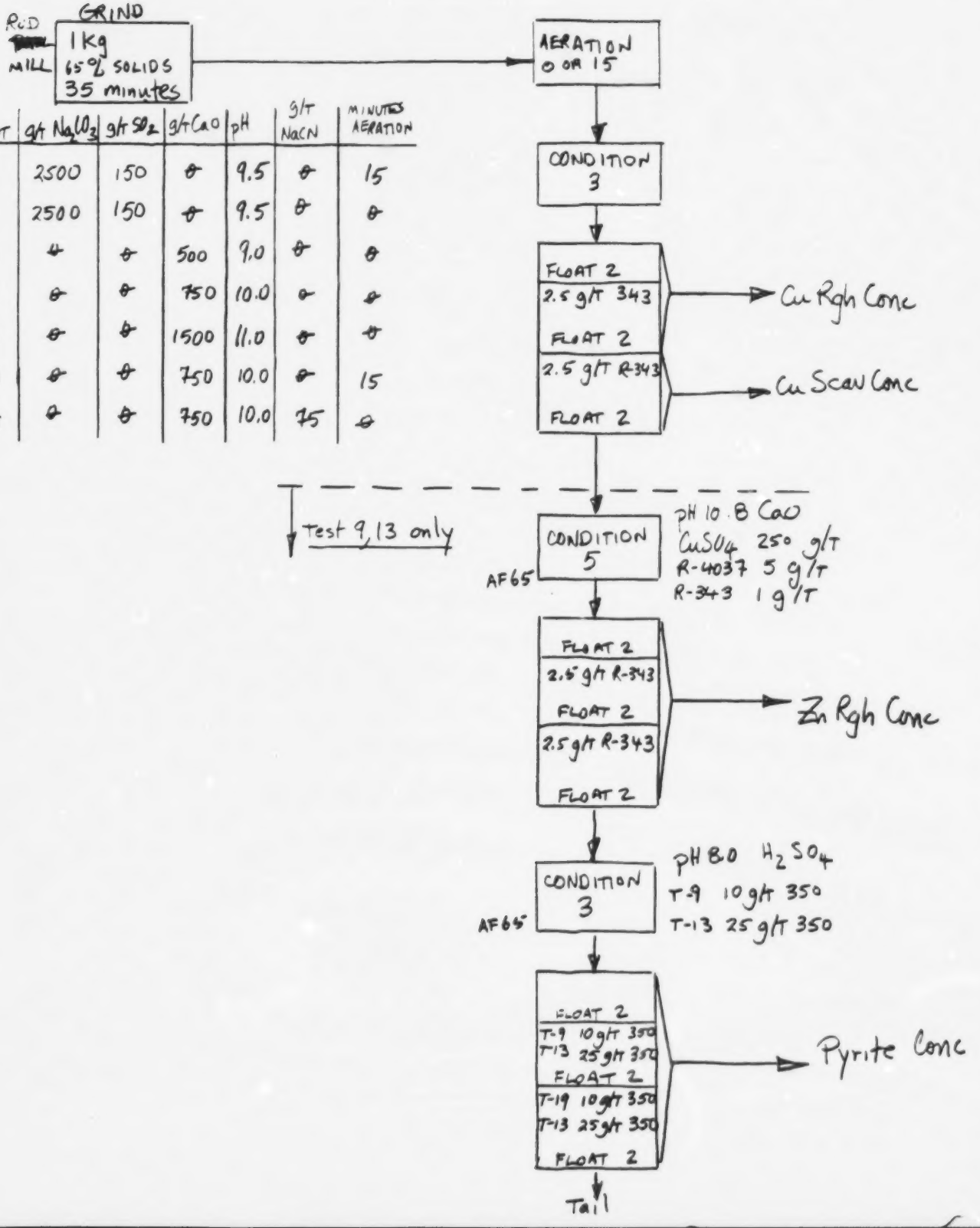
POINT LEAMINGTON DEPOSIT TEST NUMBER 7

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU CL CONC	10.1	1.01	19.3	2.76	1.75	185.8	31.77	.97	1.39	7.15
	CU 2 CL TAIL	11.3	1.12	2.27	2.24	1.65	38.1	4.18	.88	1.46	1.64
	CU 1 CL TAIL	62.8	6.25	.87	2.5	1.58	27.1	8.90	5.47	7.78	6.49
	CU SCAV CONC	31.6	3.14	1.47	3.09	1.44	36	7.57	3.40	3.57	4.34
	ZN CL CONC	4.7	.47	1.84	47.7	.93	53.1	1.41	7.81	.34	.95
	ZN 2 CL TAIL	4.3	.43	1.57	12.8	1.61	35	1.10	1.92	.54	.57
	ZN 1 CL TAIL	33.7	3.35	.62	2.72	1.27	27.1	3.41	3.19	3.35	3.48
	ZN SCAV CONC	35.2	3.50	.58	13.7	1.23	31.9	3.33	16.79	3.39	4.28
	TAIL	811.1	80.72	.29	2.11	1.23	23	38.33	59.58	78.18	71.10
	HEAD	1004.8	100.00	.61	2.86	1.27	26.11	100	100	100	100

Tests 8 - 14

LOWER COMPOSITE

29 JANUARY 1987



TEST	g/t Na_2CO_3	g/t SO_2	g/t CaO	pH	g/t NaCN	MINUTES AERATION
8	2500	150	0	9.5	0	15
9	2500	150	0	9.5	0	0
10	0	0	500	9.0	0	0
11	0	0	750	10.0	0	0
12	0	0	1500	11.0	0	0
13	0	0	750	10.0	0	15
14	0	0	750	10.0	75	0

OINT LEAMINGTON DEPOSIT TEST NUMBER 8

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
OWER	CU RGH CONC	106.4	10.52	3.09	3.17	1.42	70	55.71	10.34	11.99	23.27
	CU SCAV CONC	26.9	2.66	.9	3.92	1.4	31	4.10	3.23	2.99	2.61
	TAIL	878.5	86.83	.27	3.21	1.22	27	40.19	86.43	85.03	74.12
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	.00	0	.00	.00	.00	.00
	HEAD	1011.8	100.00	.58	3.22	1.25	31.63	100	100	100	100

POINT LEAMINGTON DEPOSIT TEST NUMBER 9

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU RGH CONC	113.8	11.25	2.89	2.86	1.37	54	55.30	11.62	12.24	21.04
	CU SCAV CONC	39.3	3.88	.77	3.67	1.37	29	5.09	5.15	4.23	3.90
	ZN RGH CONC	56.5	5.59	.55	17.8	1.3	37	5.22	35.91	5.77	7.16
	PYRITE CONC	44.6	4.41	.68	10.7	1.32	37	5.10	17.04	4.62	5.65
	TAIL	757.4	74.87	.23	1.12	1.23	24	29.29	30.29	73.14	62.25
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	.00	0	.00	.00	.00	.00
	HEAD	1011.6	100.00	.59	2.77	1.26	28.87	100	100	100	100

OINT LEAMINGTON DEPOSIT TEST NUMBER 10

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
OWER	CU RGH CONC	29.2	2.92	4.59	3.62	1.82	68	22.98	3.26	4.09	5.29
	CU SCAV CONC	18.7	1.87	3.18	3.75	1.48	69	10.19	2.17	2.13	3.44
	TAIL	950.9	95.20	.41	3.22	1.28	36	66.83	94.57	93.77	91.27
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	.00	0	.00	.00	.00	.00
	HEAD	998.8	100.00	.58	3.24	1.30	37.55	100	100	100	100

POINT LEAMINGTON DEPOSIT TEST NUMBER 11

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU RGH CONC	38.4	3.81	6.97	4.19	1.75	68	43.15	5.01	5.09	9.20
	CU SCAV CONC	16.7	1.66	2.28	4.44	1.44	59	6.14	2.31	1.82	3.47
	TAIL	953.3	94.54	.33	3.12	1.29	26	50.71	92.68	93.09	87.33
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	.00	0	.00	.00	.00	.00
	HEAD	1008.4	100.00	.62	3.18	1.31	28.15	100	100	100	100

POINT LEAMINGTON DEPOSIT TEST NUMBER 12

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU RGH CONC	31	3.05	5.89	3.95	1.95	69	32.50	3.65	4.25	6.96
	CU SCAV CONC	15.6	1.53	3.17	4.46	1.57	91	8.80	2.07	1.72	4.62
	TAIL	969.9	95.42	.34	3.26	1.38	28	58.70	94.27	94.03	88.41
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	.00	0	.00	.00	.00	.00
	HEAD	1016.5	100.00	.55	3.30	1.40	30.22	100	100	100	100

)INT LEAMINGTON DEPOSIT TEST NUMBER 13

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
)WER	CU RGH CONC	19	1.91	8.99	4.12	2.03	88	30.14	3.09	2.94	5.74
	CU SCAV CONC	16.2	1.63	4.22	4.76	1.5	80	12.06	3.05	1.85	4.45
	ZN RGH CONC	37.1	3.73	1.54	20.4	1.36	50	10.08	29.90	3.84	6.36
	PYRITE CONC	130.3	13.12	.74	9.09	1.25	41	17.01	46.78	12.41	18.33
	TAIL	790.9	79.61	.22	.55	1.31	24	30.70	17.18	78.95	65.12
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	.00	0	.00	.00	.00	.00
	HEAD	993.5	100.00	.57	2.55	1.32	29.34	100	100	100	100

'OINT LEAMINGTON DEPOSIT TEST NUMBER 14

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU RGH CONC	40.4	4.00	7.04	3.79	2.16	71	46.94	5.11	6.01	9.77
	CU SCAV CONC	19.4	1.92	1.9	4.24	1.38	45	6.08	2.74	1.84	2.97
	TAIL	949	94.07	.3	2.91	1.41	27	46.98	92.15	92.15	87.26
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	0	0	.00	.00	.00	.00
		0	.00	0	0	.00	0	.00	.00	.00	.00
	HEAD	1008.8	100.00	.60	2.97	1.44	29.11	100	100	100	100

Test 15

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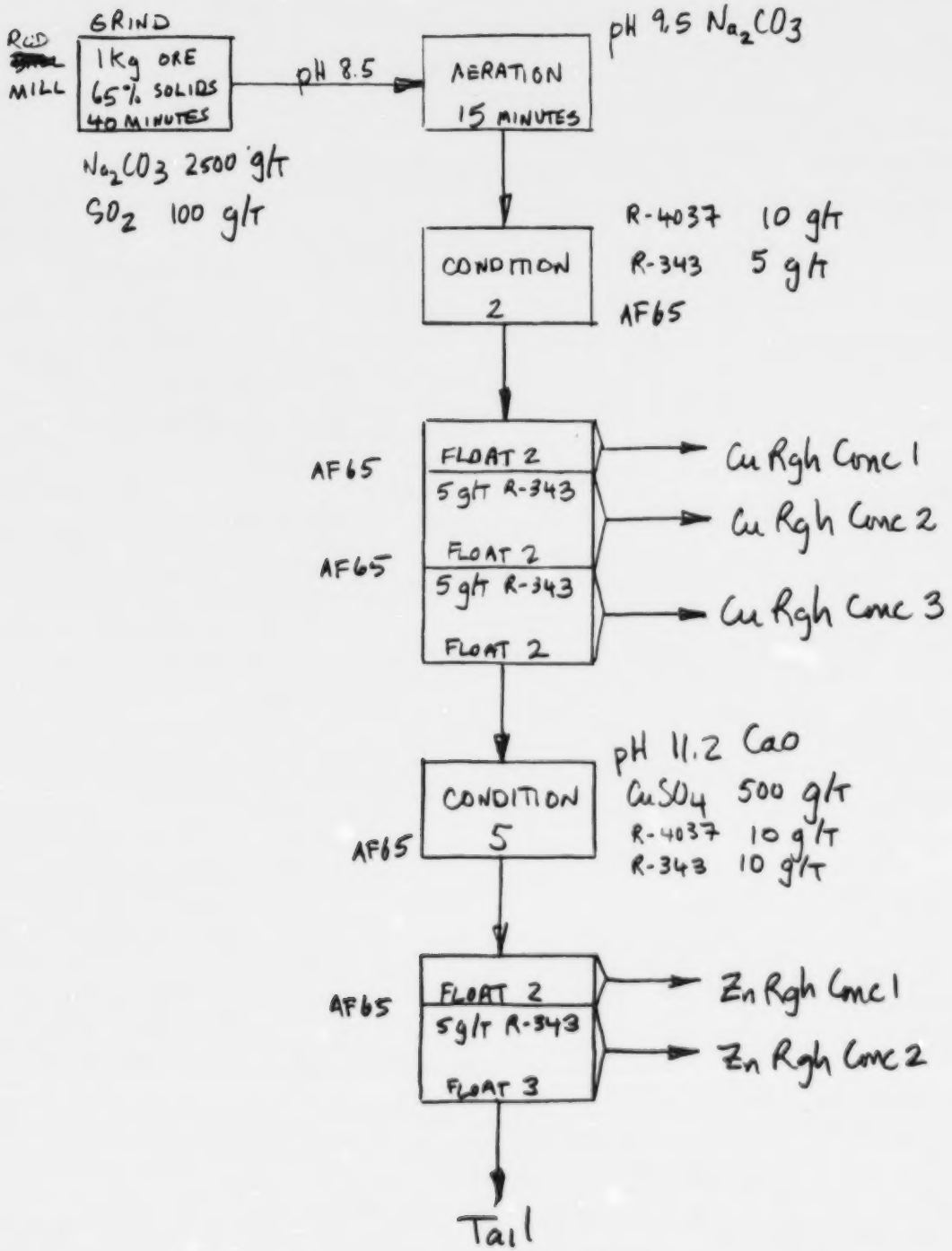
LOWER COMPOSITE

FINER GRIND PLUS INCREASED COLLECTORS



)INT LEAMINGTON DEPOSIT TEST NUMBER 15

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
)WER	CU RGH CONC 1	52.3	5.21	4.94	3.29	1.75	83	45.53	5.40	7.09	16.53
	CU RGH CONC 2	37	3.69	1.63	3.51	1.51	37	10.63	4.07	4.33	5.21
	CU RGH CONC 3	25.4	2.53	1.06	3.8	1.45	31	4.75	3.03	2.85	3.00
		0	.00	0	0	0	0	.00	.00	.00	.00
	ZN RGH CONC 1	68.4	6.81	.39	28.7	1.23	42	4.70	61.55	6.52	10.94
	ZN RGH CONC 2	31.9	3.18	.43	6.66	1.4	35	2.42	6.66	3.46	4.25
		0	.00	0	0	0	0	.00	.00	.00	.00
	TAIL	788.8	78.58	.23	.78	1.24	20	31.97	19.29	75.76	60.07
		0	.00	0	0	.00	0	.00	.00	.00	.00
	HEAD	1003.8	100.00	.57	3.18	1.29	26.16	100	100	100	100

Tests 16, 17
CaO in Cu Circuit

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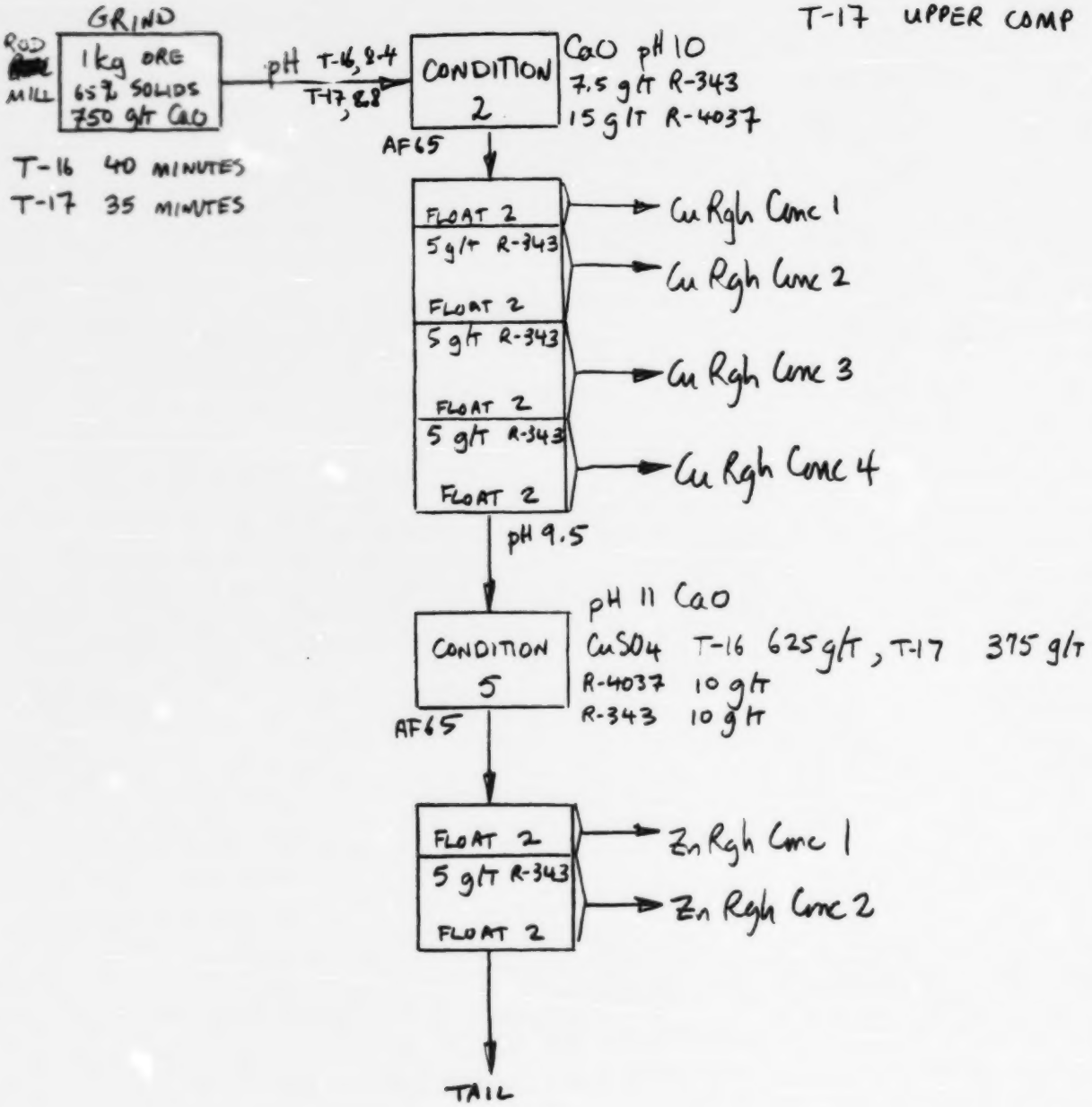
T-16 LOWER COMP
T-17 UPPER COMP



INT LEAMINGTON DEPOSIT TEST NUMBER 16

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU RGH CONC 1	50.7	4.57	4.61	3.92			36.01	5.81		
	CU RGH CONC 2	38.1	3.43	1.86	4.22			10.92	4.70		
	CU RGH CONC 3	46.3	4.17	1.09	4.03			7.78	5.45		
	CU RGH CONC 4	43.1	3.88	.7	3.99			4.65	5.03		
	ZN RGH CONC 1	85.6	7.71	.44	15.7			5.80	39.29		
	ZN RGH CONC 2	51.9	4.68	.38	7.36			3.04	11.17		
	TAIL	794	71.55	.26	1.23			31.81	28.55		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1109.7	100.00	.58	3.08			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 17

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
UPPER	CU RGH CONC 1	60.5	5.98	4.51	3.41			53.12	7.73		
	CU RGH CONC 2	44.8	4.43	1.15	3.31			10.03	5.56		
	CU RGH CONC 3	53.5	5.29	.68	3.5			7.08	7.01		
	CU RGH CONC 4	33.1	3.27	.52	3.45			3.35	4.28		
	ZN RGH CONC 1	92.3	9.12	.29	15.7			5.21	54.29		
	ZN RGH CONC 2	44.3	4.38	.3	3.79			2.59	6.29		
	TAIL	683.3	67.53	.14	.58			18.62	14.85		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1011.8	100.00	.51	2.64			100	100		

Tests 18-25
Vary Primary Grind

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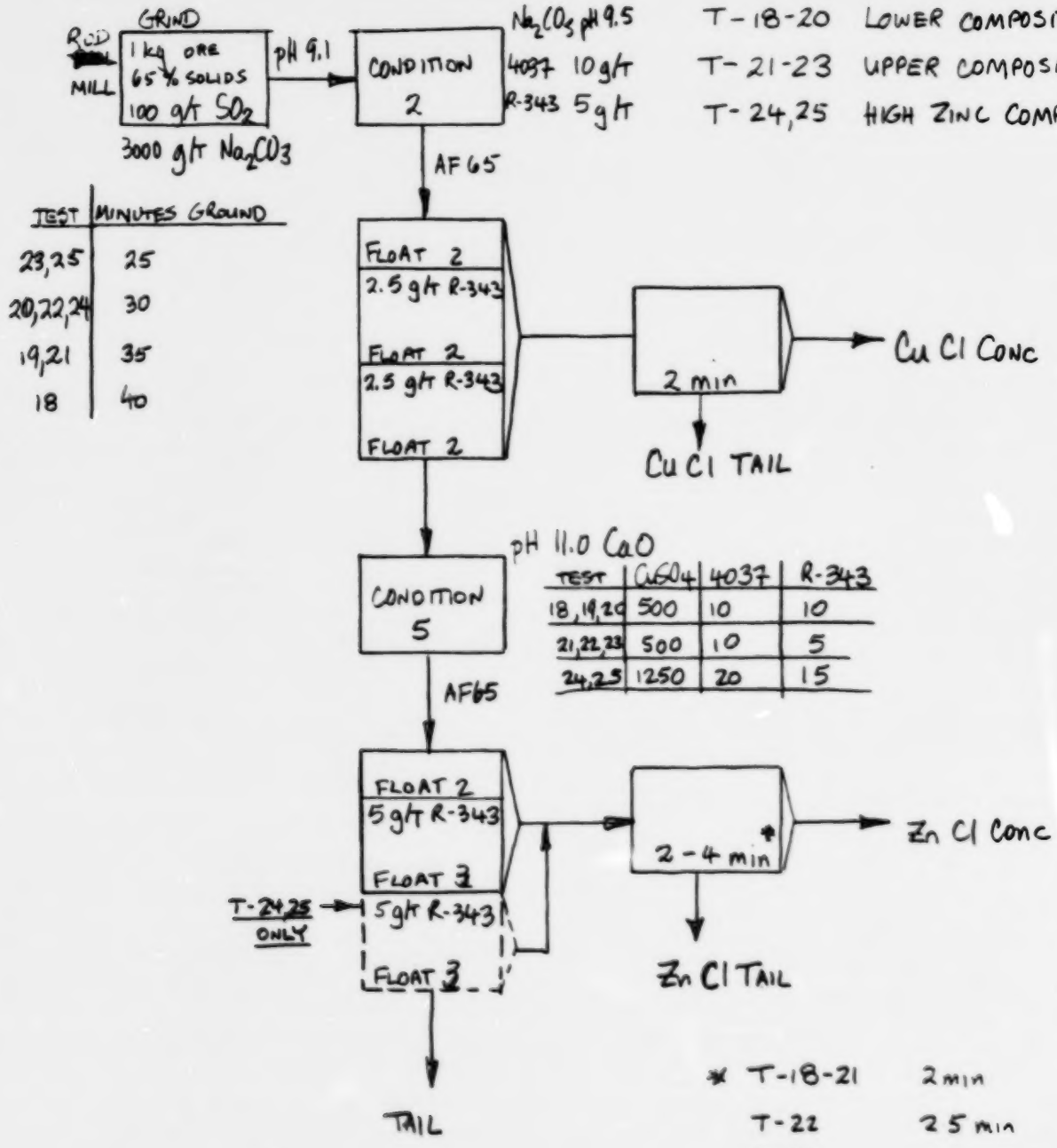


TEST	MINUTES GROUND
23,25	25
20,22,24	30
19,21	35
18	40

TEST	$CuSO_4$	4037	R-343
18,19,20	500	10	10
21,22,23	500	10	5
24,25	1250	20	15

T-18-20 LOWER COMPOSITE
T-21-23 UPPER COMPOSITE
T-24,25 HIGH ZINC COMPOSITE

* T-18-21 2 min
T-22 2.5 min
T-23 3 min
T-24,25 4 min

POINT LEAMINGTON DEPOSIT TEST NUMBER 18

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU CL CONC	53.1	5.25	5.13	2.34			49.83	4.37		
	CU CL TAIL	80.6	7.97	.59	3.04			8.70	8.62		
	ZN CL CONC	39	3.86	.49	40.2			3.50	55.16		
	ZN CL TAIL	62.7	6.20	.34	3.05			3.90	6.73		
	TAIL	776	76.73	.24	.92			34.07	25.12		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1011.4	100.00	.54	2.81			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 19

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU CL CONC	60.9	6.06	3.7	1.69			42.36	3.80		
	CU CL TAIL	105.5	10.49	.59	2.26			11.70	8.79		
	ZN CL CONC	42.4	4.22	.41	33.7			3.27	52.70		
	ZN CL TAIL	55.9	5.56	.35	2.79			3.68	5.75		
	TAIL	740.8	73.67	.28	1.06			38.99	28.96		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1005.5	100.00	.53	2.70			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 20

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU CL CONC	39.2	3.88	5.57	2.18			39.89	3.11		
	CU CL TAIL	81.4	8.06	.63	3.2			9.37	9.48		
	ZN CL CONC	37.1	3.67	.62	38.4			4.20	51.86		
	ZN CL TAIL	50.5	5.00	.44	3.46			4.06	6.36		
	TAIL	801.7	79.38	.29	1			42.48	29.18		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1009.9	100.00	.54	2.72			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 21

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
UPPER	CU CL CONC	135.4	13.47	2.07	2.16			64.91	12.43		
	CU CL TAIL	119.3	11.87	.3	2.65			8.29	13.44		
	ZN CL CONC	42	4.18	.3	31			2.92	55.35		
	ZN CL TAIL	56.2	5.59	.21	2.29			2.73	5.47		
	TAIL	652.4	64.90	.14	.48			21.15	13.31		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1005.3	100.00	.43	2.34			100	100		

'OINT LEAMINGTON DEPOSIT TEST NUMBER 22

'OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
'PPER	CU CL CONC	115.4	11.57	2.31	2.11			61.10	10.48		
	CU CL TAIL	97.1	9.73	.36	2.69			8.01	11.24		
	ZN CL CONC	37.5	3.76	.32	33.7			2.75	54.40		
	ZN CL TAIL	61.8	6.19	.21	2.2			2.97	5.85		
	TAIL	686	68.75	.16	.61			25.16	18.01		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	997.8	100.00	.44	2.33			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 23

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
UPPER	CU CL CONC	95.9	9.51	2.78	2.26			61.13	9.53		
	CU CL TAIL	102.8	10.19	.34	2.66			8.01	12.03		
	ZN CL CONC	33.8	3.35	.28	34.2			2.17	50.85		
	ZN CL TAIL	91.7	9.09	.17	1.91			3.57	7.71		
	TAIL	684.6	67.86	.16	.66			25.11	19.88		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1008.8	100.00	.43	2.25			100	100		

)INT LEAMINGTON DEPOSIT TEST NUMBER 24

MPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
GH ZN	CU CL CONC	143.2	14.12	1.92	7.95			64.87	8.58		
	CU CL TAIL	112	11.04	.31	11.5			8.19	9.70		
	ZN CL CONC	187.2	18.46	.16	50.4			7.07	71.09		
	ZN CL TAIL	59.5	5.87	.21	10.8			2.95	4.84		
	TAIL	512.2	50.51	.14	1.5			16.92	5.79		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1014.1	100.00	.42	13.09			100	100		

OINT LEAMINGTON DEPOSIT TEST NUMBER 25

OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
GH ZN	CU CL CONC	124.7	12.50	2.08	8.5			62.31	8.26		
	CU CL TAIL	82.4	8.26	.35	11.4			6.93	7.32		
	ZN CL CONC	158.4	15.87	.16	49.3			6.09	60.89		
	ZN CL TAIL	30.6	3.07	.21	14.4			1.54	3.44		
	TAIL	601.8	60.31	.16	4.28			23.13	20.08		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	997.9	100.00	.42	12.85			100	100		

APPENDIX III

CYCLOSIZING OF PRELIMINARY TEST PRODUCTS

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TESTS 18-20	+200MESH	0	0	0	0	.00	.00	.00
LOWER COMP	+270MESH	6.2	1.86	.94	1.69	2.36	2.89	5.78
CU CLNR CONCS	+30.8mic	20.9	1.94	.83	1.56	8.30	8.61	17.98
	+23.9	13.3	3.06	1.03	1.4	8.34	6.80	10.27
	+16.6	19.5	4.2	1.46	1.48	16.77	14.13	15.91
	+11.4	14.9	5.64	2.41	1.67	17.21	17.83	13.72
	+8.8	7.3	7.02	3.4	1.82	10.50	12.32	7.33
	-8.8	17.9	9.96	4.21	2.94	36.52	37.41	29.02
CALC	HEAD	100	4.88	2.01	1.814	100	100	100
ASSAY	HEAD		4.86	2.02	1.6			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TESTS 18-20	+200MESH	0	0	0	0	.00	.00	.00
LOWER COMP	+270MESH	5.4	.52	31	1.12	5.55	4.47	6.64
ZN CLNR CONCS	+32.6mic	15.4	.43	27.7	1.07	13.10	11.38	18.09
	+25.3	11.2	.43	30.6	.92	9.53	9.14	11.31
	+17.7	13.7	.39	34.4	.88	10.57	12.57	13.24
	+12.1	8.3	.35	40.9	.8	5.75	9.06	7.29
	+9.4	6.7	.61	43.5	.86	8.08	7.78	6.33
	-9.4	39.3	.61	43.5	.86	47.42	45.61	37.11
CALC	HEAD	100	.51	37.48	.91	100	100	100
ASSAY	HEAD		.53	37.9	1.03			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 18	+200MESH	0	0	0	0	.00	.00	.00
LOWER COMP	+270MESH	7.1	.31	1.25	1.46	10.28	10.21	7.55
TAIL	+33.6mic	19.2	.3	1.24	1.56	26.91	27.40	21.81
	+26.1	13.7	.24	.91	1.31	15.36	14.35	13.07
	+18.2	16.8	.18	.67	1.67	14.13	12.95	20.43
	+12.5	10.6	.13	.45	1.21	6.44	5.49	9.34
	+9.7	5.5	.11	.39	1.23	2.83	2.47	4.93
	-9.7	27.1	.19	.87	1.16	24.06	27.13	22.89
CALC	HEAD	100	.21	.87	1.37	100	100	100
ASSAY	HEAD		.24	.89	1.76			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

		SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 20		+200MESH	12.5	.4	1.6	1.18	18.43	19.01	10.91
LOWER COMP		+270MESH	18.5	.35	1.35	1.43	23.86	23.74	19.56
TAIL		+33.5mic	17.7	.33	1.22	1.48	21.52	20.52	19.37
		+25.9	9.1	.26	.91	(1.3)	8.72	7.87	8.75
		+18.1	10	.19	.66	1.17	7.00	6.27	8.65
		+12.4	7.1	.15	.49	(1.3)	3.92	3.31	6.83
		+9.6	4	.12	.43	1.33	1.77	1.63	3.93
		-9.6	21.1	.19	.88	1.41	14.77	17.65	22.00
	CALC	HEAD	100	.27	1.05	1.35	100	100	100
	ASSAY	HEAD		.3	1.08	1.44			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 21	+200MESH	0	0	0	0	.00	.00	.00
UPPER COMP	+270MESH	3	1.17	1.18	(1)	1.57	1.65	2.45
CU CLNR CONC	+30.5mic	24.1	.91	.87	1.32	9.81	9.75	26.02
	+23.6	16.2	1.25	1.3	.92	9.06	9.79	12.19
	+16.5	21.4	1.69	1.82	.9	16.18	18.11	15.75
	+11.3	14.4	2.4	2.86	.97	15.46	19.15	11.42
	+8.8	6.4	3.25	3.66	1.16	9.31	10.89	6.07
	-8.8	14.5	5.95	4.55	2.2	38.60	30.67	26.09
CALC	HEAD	100	2.23	2.15	1.22	100	100	100
ASSAY	HEAD		2.13	1.99	.99			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 21-23	+200MESH	0	0	0	0	.00	.00	.00
UPPER COMP	+270MESH	6.6	.3	23.3	1.25	7.09	4.60	9.50
ZN CLNR CONC	+33.2mic	13.6	.27	20.7	1.04	13.15	8.42	16.29
	+25.7	18.2	.26	26.3	.81	16.95	14.32	16.98
	+18	18.2	.25	31.8	.62	16.30	17.31	13.00
	+12.3	12.8	.19	40.3	.66	8.71	15.43	9.73
	+9.5	6.9	.19	45.1	.7	4.70	9.31	5.56
	-9.5	23.7	.39	43.2	1.06	33.11	30.62	28.94
CALC	HEAD	100	.28	33.44	.87	100	100	100
ASSAY	HEAD		.31	32.5	.73			

:LOSIZING OF TEST PRODUCTS

WGT	ASSAYS % OR G/T			% DISTRIBUTION		
%	CU	ZN	AU	CU	ZN	AU
0	0	0	0	.00	.00	.00
8.8	.21	.68	.69	14.05	14.24	9.35
18.9	.2	.54	.84	28.74	24.29	24.45
13.5	.16	.43	.68	16.42	13.81	14.14
17.1	.09	.3	.52	11.70	12.21	13.69
11.3	.08	.2	.5	6.87	5.38	8.70
5.9	.08	.19	.55	3.59	2.67	5.00
24.5	.1	.47	.654	18.63	27.40	24.67
100	.13	.42	.65	100	100	100
	.15	.46	.72			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 23	+200MESH	0	0	0	0	.00	.00	.00
UPPER COMP	+270MESH	17.3	.22	.85	.65	25.70	23.37	19.26
TAIL	+35.3mic	17.8	.2	.76	1.09	24.04	21.50	33.23
	+27.3	11.8	.14	.57	.64	11.16	10.69	12.93
	+19.1	15.1	.1	.42	.26	10.20	10.08	6.72
	+13.1	10	.09	.32	.11	6.08	5.08	1.88
	+10.1	5.2	.08	.3	.11	2.81	2.48	.98
	-10.1	22.8	.13	.74	.64	20.02	26.81	24.99
CALC	HEAD	100	.15	.63	.58	100	100	100
ASSAY	HEAD		.16	.63	.55			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 24	+200MESH	0	0	0	0	.00	.00	.00
HIGH ZN COMP	+270MESH	8.3	1.13	7.24	5.75	4.55	7.70	7.13
CU CLNR CONC	+30.8mic	31.6	.92	5.47	7.77	14.09	22.14	36.69
	+23.9	13.2	1.34	7.29	5.42	8.57	12.32	10.69
	+16.6	20.5	1.7	8.37	5.77	16.89	21.98	17.68
	+11.4	11.6	2.49	9.99	6.86	14.00	14.84	11.89
	+8.8	4.5	3.57	11.3	7.65	7.79	6.51	5.14
	-8.8	10.3	6.83	11	(7)	34.10	14.51	10.77
CALC	HEAD	100	2.06	7.81	6.69	100	100	100
ASSAY	HEAD		1.89	7.19	7.13			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 24	+200MESH	0	0	0	0	.00	.00	.00
HIGH ZN COMP	+270MESH	7.7	.2	43.6	4.59	9.37	6.65	13.99
ZN CLNR CONC	+33.4mic	18.5	.15	44.7	4.18	16.89	16.37	30.61
	+25.9	15	.14	49	2.67	12.78	14.55	15.85
	+18.1	20	.12	52.4	2.01	14.61	20.75	15.91
	+12.4	13.7	.12	54.2	1.54	10.01	14.70	8.35
	+9.6	6.6	.12	55.8	1.28	4.82	7.29	3.34
	-9.6	18.5	.28	53.8	1.63	31.53	19.70	11.94
CALC	HEAD	100	.16	50.52	2.53	100	100	100
ASSAY	HEAD		.14	50.4	2.59			

POINT LEAMINGTON DEPOSIT CYCLOSIZING OF TEST PRODUCTS

	SIZE MESH or MICRONS	WGT %	ASSAYS % OR G/T CU	ZN	AU	% DISTRIBUTION CU	ZN	AU
TEST 24	+200MESH	0	0	0	0	.00	.00	.00
HIGH ZN COMP	+270MESH	8	.16	1.38	4.22	10.46	7.91	9.64
TAIL	+34mic	18.3	.14	1.15	4.48	20.93	15.08	23.41
	+26.4	12.1	.11	.97	3.49	10.88	8.41	12.06
	+18.4	16.4	.08	.76	2.97	10.72	8.93	13.91
	+12.7	11.5	.08	.71	2.8	7.52	5.85	9.19
	+9.8	6.2	.07	.8	2.79	3.55	3.55	4.94
	-9.8	27.5	.16	2.55	3.42	35.95	50.26	26.85
CALC	HEAD	100	.12	1.40	3.50	100	100	100
ASSAY	HEAD		.13	1.55	3.63			

APPENDIX IV

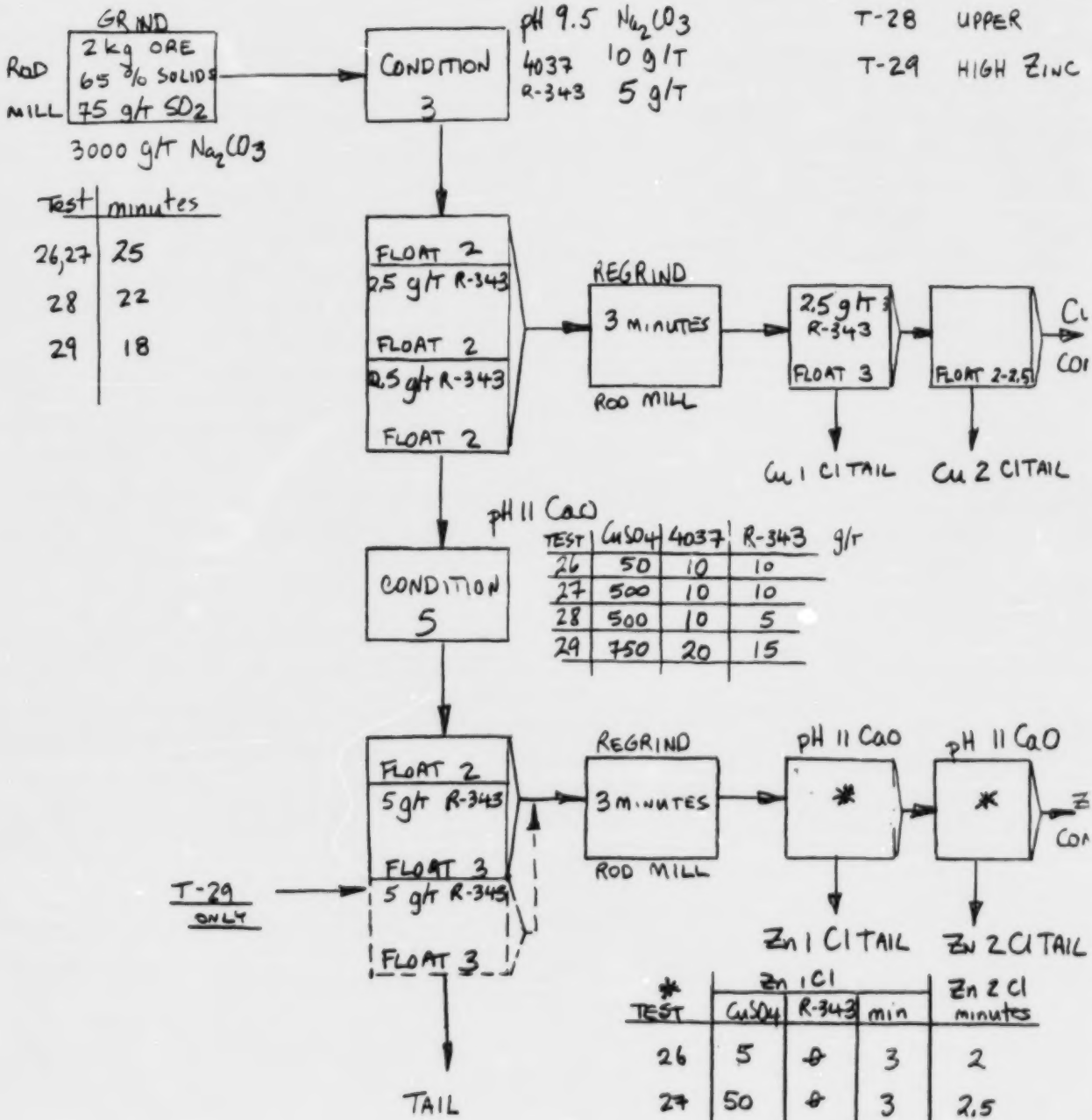
EXTENSIVE BENCH TESTS

DETAILED PROCEDURES AND RESULTS

Tests 26 - 29
2kg charges

7 JULY /87

T-26,27 LOWER
T-28 UPPER
T-29 HIGH ZINC



Test	minutes
26,27	25
28	22
29	18

TEST	CuSO4	4037	R-343	g/T
26	50	10	10	
27	500	10	10	
28	500	10	5	
29	750	20	15	

* TEST	Zn 1 CI CuSO4	Zn 1 CI R-343	Zn 1 CI min	Zn 2 CI minutes
26	5	0	3	2
27	50	0	3	2.5
28	50	0	3	2.5
29	75	5	3	2.5

OINT LEAMINGTON DEPOSIT TEST NUMBER 26

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
OWER	CU CL CONC	36.3	1.80	15.2	3.42			48.77	2.32		
	CU 2 CL TAIL	30	1.49	2	3.9			5.30	2.19		
	CU 1 CL TAIL	120.5	5.98	.65	3.1			6.92	6.99		
	ZN RGH CONC	148.2	7.36	.71	6.73			9.30	18.67		
	TAIL	1679.7	83.37	.2	2.22			29.70	69.82		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	2014.7	100.00	.56	2.65			100	100		

)INT LEAMINGTON DEPOSIT TEST NUMBER 27

OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
)WER	CU CL CONC	22.1	1.11	10.4	3.59			27.45	1.41		
	CU 2 CL TAIL	44.2	2.22	1.11	3.47			5.86	2.73		
	CU 1 CL TAIL	130.4	6.54	.47	3.19			7.32	7.39		
	ZN CL CONC	64.3	3.23	.47	45.1			3.61	51.55		
	ZN 2 CL TAIL	23.4	1.17	.38	7.71			1.06	3.21		
	ZN 1 CL TAIL	110.9	5.57	.24	2.41			3.18	4.75		
	TAIL	1597.2	80.16	.27	1.02			51.51	28.96		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1992.5	100.00	.42	2.82			100	100		

INT LEAMINGTON DEPOSIT TEST NUMBER 28

MPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
PER	CU CL CONC	139.2	6.98	4	3.03			61.85	9.32		
	CU 2 CL TAIL	58.3	2.92	.52	2.59			3.37	3.34		
	CU 1 CL TAIL	160.8	8.06	.35	2.9			6.25	10.31		
	ZN CL CONC	65.4	3.28	.29	34.9			2.11	50.46		
	ZN 2 CL TAIL	45.3	2.27	.2	7.22			1.01	7.23		
	ZN 1 CL TAIL	189.9	9.52	.15	1.23			3.16	5.16		
	TAIL	1335.8	66.97	.15	.48			22.26	14.17		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1994.7	100.00	.45	2.27			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 29

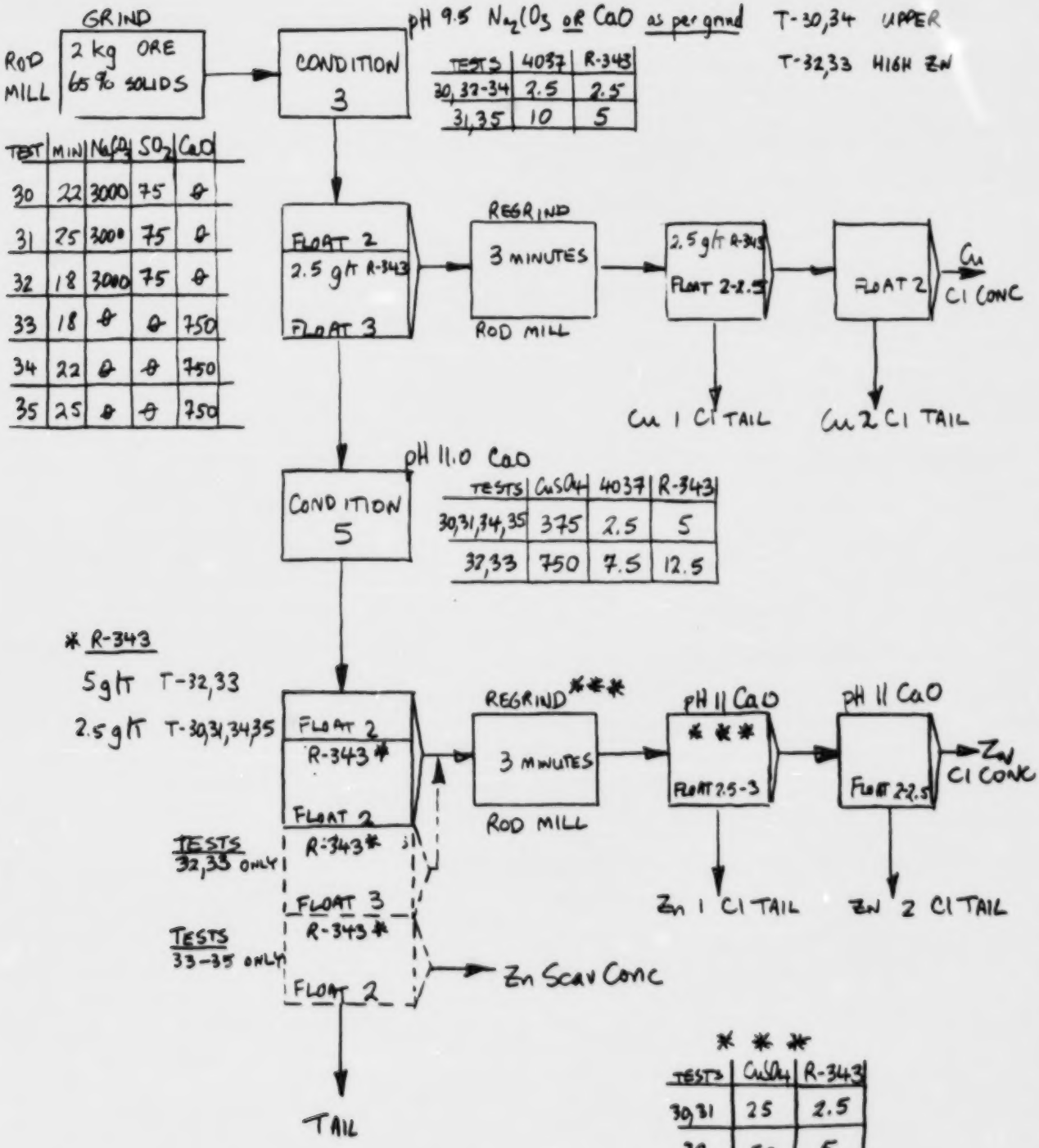
COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	167.8	8.41	3.25	9.59			64.65	6.04		
	CU 2 CL TAIL	49	2.46	.53	10.6			3.08	1.95		
	CU 1 CL TAIL	137.7	6.90	.29	13.1			4.73	6.77		
	ZN CL CONC	219.9	11.02	.15	53			3.91	43.76		
	ZN 2 CL TAIL	38.2	1.91	.15	11.2			.68	1.61		
	ZN 1 CL TAIL	132.6	6.65	.14	6.94			2.20	3.46		
	TAIL	1249.9	62.65	.14	7.76			20.74	36.42		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1995.1	100.00	.42	13.35			100	100		

Tests 30-35

Lime vs Soda Ash

14,15 JULY / 87

T-31,35 LOWER
T-30,34 UPPER
T-32,33 HIGH Zn



no Zn REGRIND OR Zn cleaning T-33-35

POINT LEAMINGTON DEPOSIT TEST NUMBER 30

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
UPPER	CU CL CONC	24.9	1.25	15	3.78			44.50	2.10		
	CU 2 CL TAIL	27.5	1.39	1.8	3.7			5.90	2.27		
	CU 1 CL TAIL	141.8	7.15	.64	2.84			10.81	8.98		
	ZN CL CONC	56.8	2.86	.44	45			2.98	56.99		
	ZN 2 CL TAIL	14.8	.75	.33	3.04			.58	1.00		
	ZN 1 CL TAIL	87.7	4.42	.21	1.64			2.19	3.21		
	TAIL	1630.9	82.19	.17	.7			33.03	25.45		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1984.4	100.00	.42	2.26			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 31

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU CL CONC	39.3	1.97	12.6	3.06			44.86	2.34		
	CU 2 CL TAIL	27.3	1.37	1.65	3.77			4.08	2.01		
	CU 1 CL TAIL	140.6	7.05	.69	3.2			8.79	8.77		
	ZN CL CONC	35.3	1.77	.55	46.4			1.76	31.92		
	ZN 2 CL TAIL	16.8	.84	.64	21.2			.97	6.94		
	ZN 1 CL TAIL	90	4.51	.28	2.52			2.28	4.42		
	TAIL	1645.4	82.49	.25	1.36			37.26	43.61		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1994.7	100.00	.55	2.57			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 32

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	83.6	4.16	5.5	8.06			55.58	2.65		
	CU 2 CL TAIL	47	2.34	.96	7.97			5.45	1.47		
	CU 1 CL TAIL	128	6.37	.43	9.33			6.65	4.70		
	ZN CL CONC	279.9	13.92	.15	51.3			5.08	56.50		
	ZN 2 CL TAIL	36.3	1.81	.2	31.4			.88	4.49		
	ZN 1 CL TAIL	88.4	4.40	.18	12.4			1.92	4.31		
	TAIL	1347.5	67.02	.15	4.88			24.43	25.88		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	2010.7	100.00	.41	12.64			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 33

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	18.5	.93	15.2	8.81			36.22	.66		
	CU 2 CL TAIL	11.5	.58	3.81	11.4			5.64	.53		
	CU 1 CL TAIL	56	2.80	1.93	11			13.92	2.48		
	ZN RGH CONC	429.5	21.50	.23	43.4			12.73	75.02		
	ZN SCAV CONC	36.2	1.81	.36	31.3			1.68	4.56		
	TAIL	1446.1	72.38	.16	2.88			29.81	16.76		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1997.8	100.00	.39	12.44			100	100		

OINT LEAMINGTON DEPOSIT TEST NUMBER 34

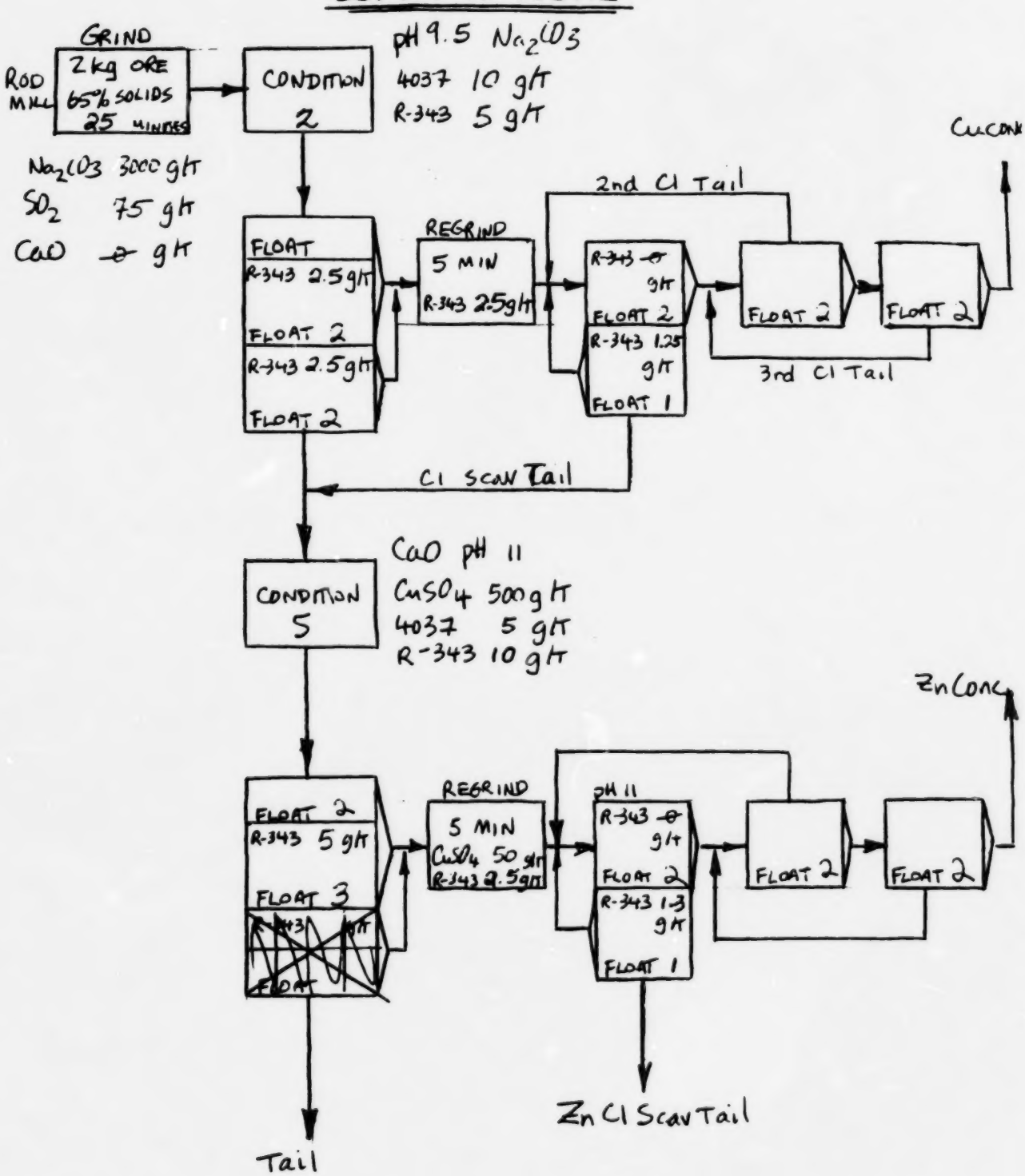
OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
PPER	CU CL CONC	13.2	.65	20	3.12			32.44	.96		
	CU 2 CL TAIL	12.1	.60	5.02	4.1			7.46	1.15		
	CU 1 CL TAIL	74.2	3.67	1.25	3.06			11.40	5.27		
	ZN RGH CONC	102.1	5.05	.72	21.1			9.03	50.01		
	ZN SCAV CONC	28.6	1.42	.64	9.08			2.25	6.03		
	TAIL	1790.7	88.61	.17	.88			37.41	36.58		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	2020.9	100.00	.40	2.13			100	100		

POINT LEAMINGTON DEPOSIT TEST NUMBER 35

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
LOWER	CU CL CONC	16.5	.83	21.4	2.09			31.88	.68		
	CU 2 CL TAIL	11.6	.58	5.56	4.54			5.82	1.03		
	CU 1 CL TAIL	70.9	3.55	1.99	3.68			12.74	5.11		
	ZN RGH CONC	72.8	3.64	1.08	24.8			7.10	35.38		
	ZN SCAV CONC	22.6	1.13	.87	13.2			1.77	5.85		
	TAIL	1803.1	90.27	.25	1.47			40.69	51.95		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
		0	.00	0	0			.00	.00		
	HEAD	1997.5	100.00	.55	2.55			100	100		

LOCKED CYCLE TEST 36

LOWER COMPOSITE



OINT LEAMINGTON DEPOSIT TEST NUMBER 36

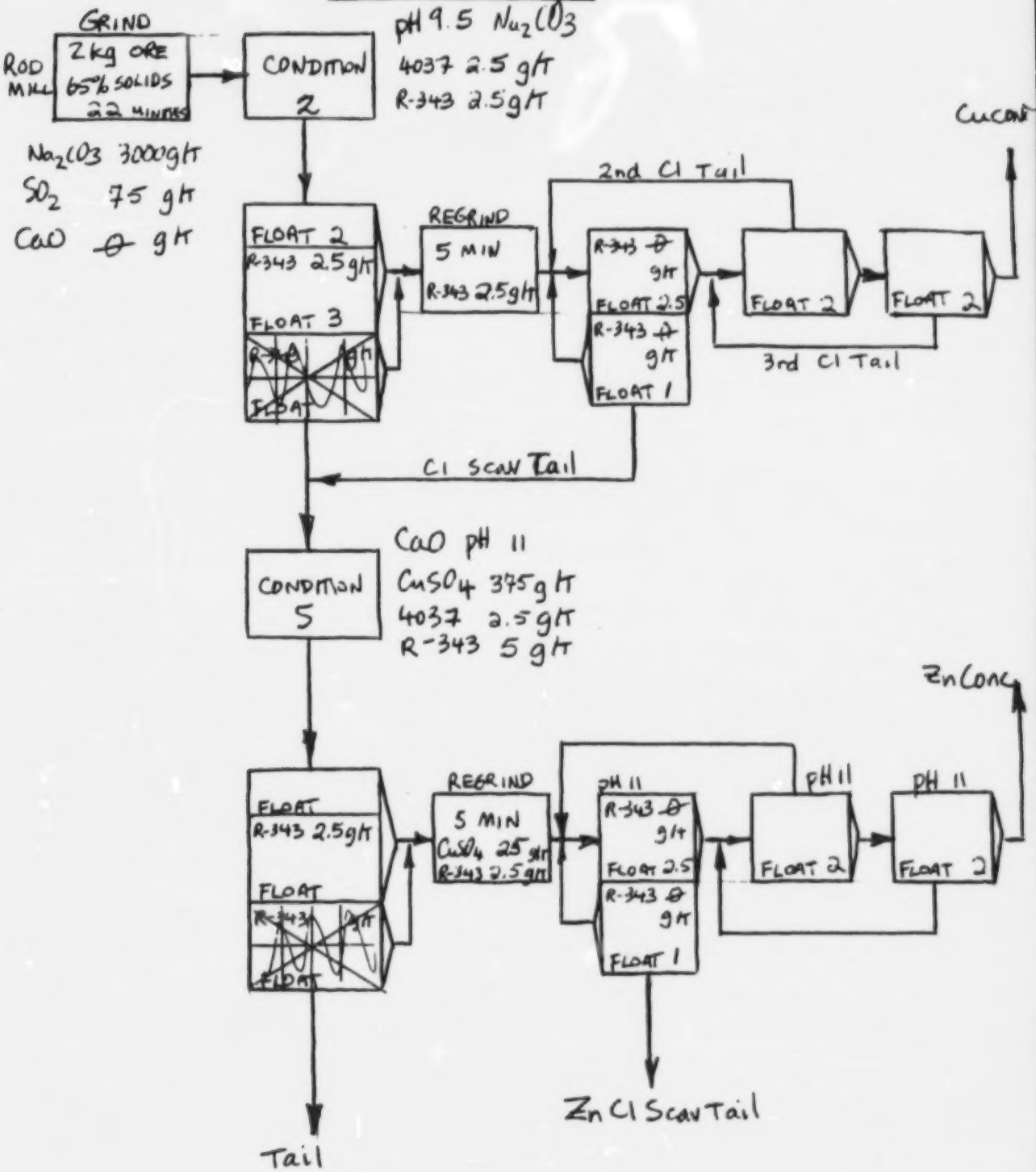
OMPOSITE	PRODUCT	WEIGHT gms	%	ASSAYS % OR G/T CU	ZN	AU	AG	% DISTRIBUTION CU	ZN	AU	AG
OWER	CU CL CONC 1	36.2	.46	14.8	2.39			11.44	.41		
	CU CL CONC 2	30.9	.39	16.8	2.69			11.09	.40		
	CU CL CONC 3	31.9	.40	16.7	2.79	.237	21.4	11.38	.42		
	CU CL CONC 4	31.3	.39	17.8	2.65			11.90	.40		
	CU SCAV CONC 4	25.7	.32	3.12	3.62			1.71	.44		
	CU 3 CL TAIL 4	14.1	.18	3.1	3.89			.93	.26		
	CU 2 CL TAIL 4	42.5	.54	1.84	3.67			1.67	.74		
	CU CL SC TL 4	174	2.19	.96	3.15			3.57	2.62		
		0	.00	0	0						
	ZN CL CONC 1	41.3	.52	.42	48.3			.37	9.52		
	ZN CL CONC 2	39.3	.49	.53	50.9			.44	9.55		
	ZN CL CONC 3	57	.72	.77	50.8	.061	47.7	.94	13.82		
	ZN CL CONC 4	54.7	.69	.98	50			1.14	13.05		
	ZN SCAV CONC 4	13.3	.17	1.25	25.3			.36	1.61		
	ZN 3 CL TAIL4	11.6	.15	1.23	22.4			.30	1.24		
	ZN 2 CL TAIL 4	34.6	.44	.83	10.6			.61	1.75		
	ZN CL SC TL 1	148.1	1.86	.27	1.65			.85	1.17		
	ZN CL SC TL 2	190.2	2.40	.35	3.25			1.42	2.95		
	ZN CL SC TL 3	171.3	2.16	.39	3.04	.113	23.3	1.43	2.49		
	ZN CL SC TL 4	146	1.84	.5	3.79			1.56	2.64		
	TAIL 1	1490.2	18.77	.27	1.02			8.59	7.25		
	TAIL 2	1693.3	21.32	.26	1.17			9.40	9.46		
	TAIL 3	1641.9	20.68	.25	1.03	1.26	20.9	8.77	8.07		
	TAIL 4	1821.9	22.94	.26	1.12			10.12	9.74		
	HEAD	7941.3	100.00	.59	2.64			100	100		

OINT LEAMINGTON DEPOSIT CYCLE TEST 36 PREDICTED RESULTS CYCLES 3+4

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
OWER	CU CL CONC	31.6	1.60	17.2	2.7	2.37	214	48.79	1.60	3.03	13.71
	ZN CL CONC	55.9	2.83	.9	50.4	.61	47.7	4.52	52.69	1.38	5.41
	ZN CL SCAV TAIL	158.7	8.02	.44	3.4	1.13	23.3	6.27	10.09	7.26	7.50
	ZN SCAV TAIL	1731.9	87.55	.26	1.1	1.26	20.9	40.42	35.63	88.33	73.39
	OVERALL TAIL		95.58	.28	1.29	1.25	21.10	46.69	45.72	95.59	80.88
	HEAD	1978.1	100.00	.56	2.70	1.25	24.93	100	100	100	100

LOCKED CYCLE TEST 37

UPPER COMPOSITE



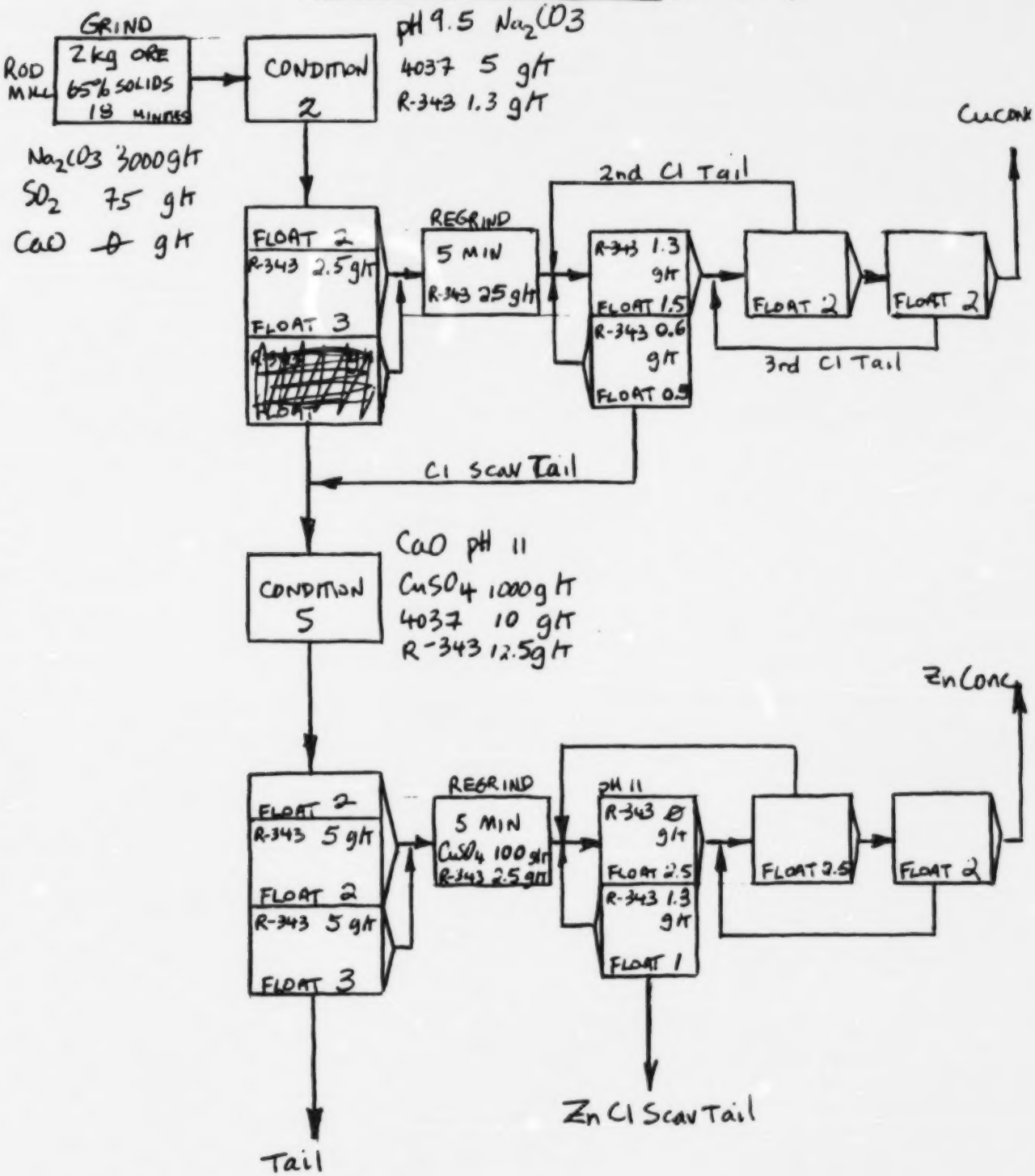
POINT LEAMINGTON DEPOSIT TEST NUMBER 37

OMPOSITE PRODUCT		WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
PER	CU CL CONC 1	55	.68	8.89	2.68			13.53	.82		
	CU CL CONC 2	44	.55	11.3	3.86			13.75	.95		
	CU CL CONC 3	48.4	.60	10.6	3.86	219	54.5	14.19	1.05		
	CU CL CONC 4	35.1	.44	13.1	3.49			12.72	.69		
	CU SCAV CONC 4	15.4	.19	1.75	2.92			.75	.25		
	CU 3 CL TAIL 4	22.3	.28	2.01	3.12			1.24	.39		
	CU 2 CL TAIL 4	68.7	.85	1.02	2.47			1.94	.95		
	CU CL SC TL 4	238.5	2.96	.36	2.17			2.38	2.90		
		0	.00	0							
	ZN CL CONC 1	38.1	.47	.38	52.1			.40	11.10		
	ZN CL CONC 2	50.8	.63	.49	48.7			.69	13.84		
	ZN CL CONC 3	50.6	.63	.69	49.2	0.55	48.8	.97	13.93		
	ZN CL CONC 4	46.7	.58	.54	49.1			.70	12.83		
	ZN SCAV CONC 4	12.6	.16	.57	13.7			.20	.97		
	ZN 3 CL TAIL4	8.5	.11	.81	14.4			.19	.68		
	ZN 2 CL TAIL 4	31.4	.39	.56	7.34			.49	1.29		
	ZN CL SC TL 1	79.1	.98	.22	1.87			.48	.83		
	ZN CL SC TL 2	116.1	1.44	.27	1.84			.87	1.20		
	ZN CL SC TL 3	149.4	1.86	.24	1.34	0.56	18.9	.99	1.12		
	ZN CL SC TL 4	141.7	1.76	.29	1.9			1.14	1.51		
	TAIL 1	1580.6	19.63	.18	.86			7.87	7.60		
	TAIL 2	1725.8	21.44	.18	.82			8.59	7.92		
	TAIL 3	1759.3	21.85	.17	.92	0.61	16.6	8.27	9.05		
	TAIL 4	1733	21.53	.16	.84			7.67	8.14		
	HEAD	8051.1	100.00	.45	2.22			100	100		

POINT LEAMINGTON DEPOSIT CYCLE TEST 37 PREDICTED RESULTS CYCLES 3+4

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
UPPER	CU CL CONC	41.8	2.11	11.6	3.7	2.19	54.5	58.22	3.58	7.24	6.26
	ZN CL CONC	48.7	2.46	.6	49.2	.55	48.8	3.51	55.46	2.12	6.53
	ZN CL SCAV TAIL	145.6	7.35	.27	1.6	.56	18.9	4.72	5.39	6.45	7.56
	ZN SCAV TAIL	1746.2	88.09	.16	.88	.61	16.6	33.55	35.57	84.20	79.65
	OVERALL TAIL		95.43	.17	.94	.61	16.78	38.27	40.96	90.65	87.21
	HEAD	1982.3	100.00	.42	2.18	.64	18.36	100	100	100	100

LOCKED CYCLE TEST 38
HIGH ZINC COMPOSITE (Na_2CO_3)



POINT LEAMINGTON DEPOSIT TEST NUMBER 38

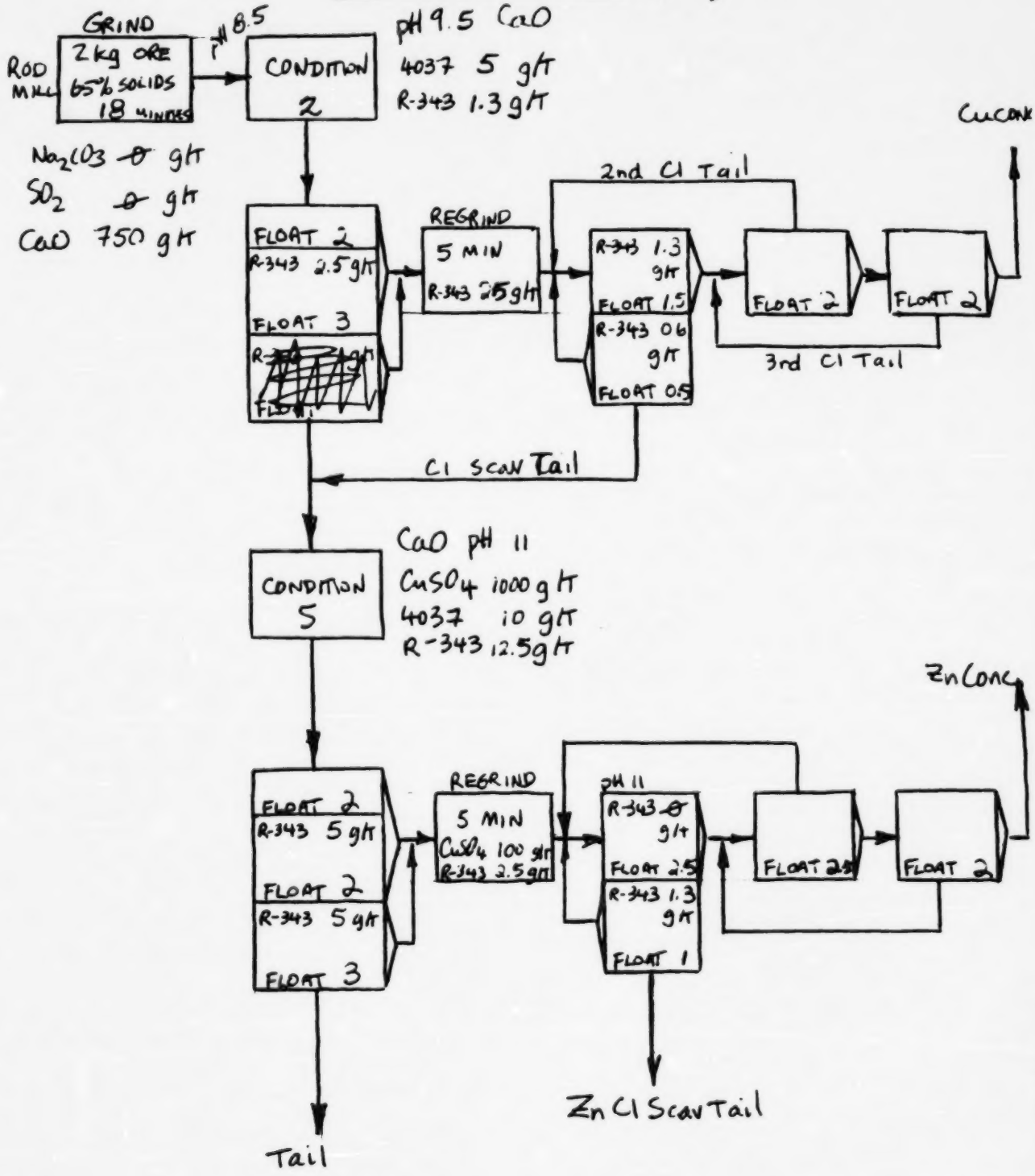
COMPOSITE	PRODUCT	WEIGHT gms	WEIGHT %	ASSAYS % OR G/T CU	ZN	AU	AG	% DISTRIBUTION CU	ZN	AU	AG
IGH ZN	CU CL CONC 1	34.8	.43	10.8	8.31			10.93	.29		
	CU CL CONC 2	63.6	.79	6.84	8.9			12.66	.56		
	CU CL CONC 3	78.6	.98	5.74	8.24	202	109	13.13	.64		
	CU CL CONC 4	36.9	.46	10.7	8.32			11.49	.30		
	CU SCAV CONC 4	22.4	.28	2.14	9.65			1.39	.21		
	CU 3 CL TAIL 4	16.1	.20	1.51	8.78			.71	.14		
	CU 2 CL TAIL 4	53.8	.67	1	9.27			1.57	.49		
	CU CL SC TL 4	213.8	2.67	.55	12			3.42	2.54		
		0	.00	0							
	ZN CL CONC 1	275.4	3.44	.19	55.4			1.52	15.10		
	ZN CL CONC 2	321.3	4.01	.21	52.8			1.96	16.79		
	ZN CL CONC 3	322.1	4.02	.23	53.8	1.47	43.6	2.16	17.15		
	ZN CL CONC 4	327	4.09	.23	52.7			2.19	17.06		
	ZN SCAV CONC 4	49.8	.62	.34	39.5			.49	1.95		
	ZN 3 CL TAIL4	23.1	.29	.54	35.4			.36	.81		
	ZN 2 CL TAIL 4	114.2	1.43	.34	27.6			1.13	3.12		
	ZN CL SC TL 1	154.1	1.93	.2	7.66			.90	1.17		
	ZN CL SC TL 2	267.6	3.34	.23	9.14			1.79	2.42		
	ZN CL SC TL 3	271.6	3.39	.24	9.46	3.74	50.9	1.90	2.54		
	ZN CL SC TL 4	240.7	3.01	.27	9.97			1.89	2.38		
	TAIL 1	1136.5	14.20	.17	1.74			5.62	1.96		
	TAIL 2	1287.5	16.09	.19	2.76			7.12	3.52		
	TAIL 3	1313.2	16.41	.19	2.91	3.79	49.0	7.26	3.78		
	TAIL 4	1379.5	17.24	.21	3.72			8.43	5.08		
	HEAD	8003.6	100.00	.43	12.62			100	100		

POINT LEAMINGTON DEPOSIT CYCLE TEST 38 PREDICTED RESULTS CYCLES 3+4

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	57.8	2.91	7.3	8.3	20.2	109	50.84	1.94	14.76	6.33
	ZN CL CONC	324.6	16.35	.23	53.2	1.47	43.6	9.00	69.98	6.03	14.23
	ZN CL SCAV TAIL	256.2	12.91	.25	9.7	3.74	50.9	7.72	10.07	12.12	13.11
	ZN SCAV TAIL	1346.4	67.83	.2	3.3	3.94	49	32.45	18.01	67.08	66.33
	OVERALL TAIL		80.74	.21	4.33	3.91	49.37	40.16	28.08	79.20	79.44
	HEAD	1985	100.00	.42	12.45	3.99	50.18	100	100	100	100

LOCKED CYCLE TEST 39

HIGH Zn COMPOSITE (CaO)



POINT LEAMINGTON DEPOSIT TEST NUMBER 39

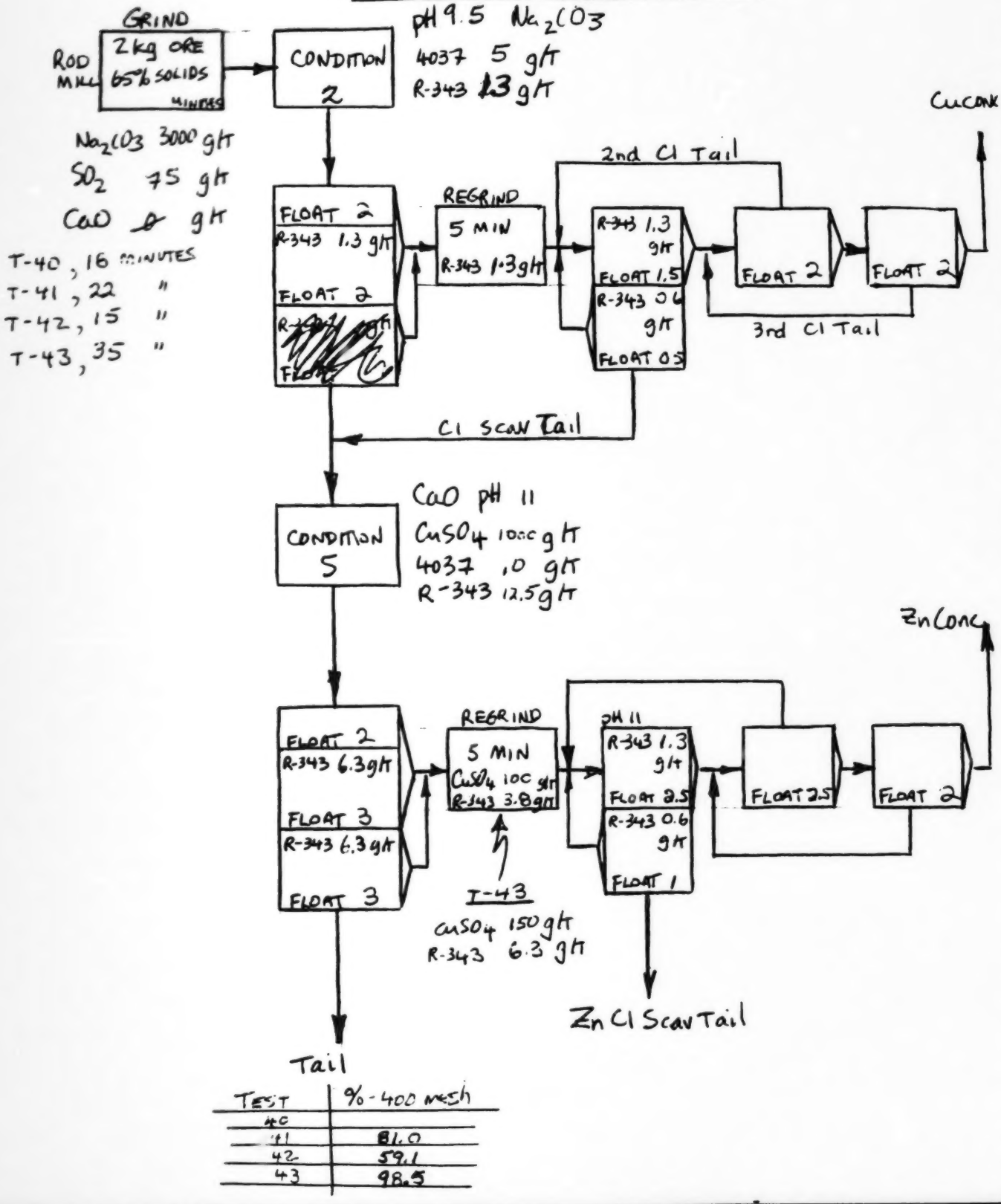
OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
IGH ZN	CU CL CONC 1	15.4	.20	19.5	7.19			8.99	.11		
	CU CL CONC 2	16.8	.22	16.6	7.69			8.35	.13		
	CU CL CONC 3	18.1	.23	17.5	7.6	48.3	173	9.48	.13		
	CU CL CONC 4	14.1	.18	19.8	7.35			8.36	.10		
	CU SCAV CONC 4	3.4	.04	6.75	10.1			.69	.03		
	CU 3 CL TAIL 4	4.5	.06	5.46	10.9			.74	.05		
	CU 2 CL TAIL 4	13.4	.17	3.59	10.7			1.44	.14		
	CU CL SC TL 4	109.4	1.40	1.18	12.7			3.87	1.35		
		0	.00	0							
	ZN CL CONC 1	211.7	2.72	.18	58.1			1.14	11.98		
	ZN CL CONC 2	239.9	3.08	.26	56.9			1.87	13.30		
	ZN CL CONC 3	277.5	3.56	.29	57.3	1.46	41.2	2.41	15.49		
	ZN CL CONC 4	302.4	3.88	.3	57			2.72	16.79		
	ZN SCAV CONC 4	56.8	.73	.54	45.7			.92	2.53		
	ZN 3 CL TAIL4	60.4	.78	.58	48.2			1.05	2.84		
	ZN 2 CL TAIL 4	115.3	1.48	.6	40.5			2.07	4.55		
	ZN CL SC TL 1	177.9	2.28	.23	14.7			1.23	2.55		
	ZN CL SC TL 2	221.9	2.85	.43	13.5			2.86	2.92		
	ZN CL SC TL 3	231.1	2.97	.51	18.7	3.78	55.2	3.53	4.21		
	ZN CL SC TL 4	239.7	3.08	.48	20.3			3.45	4.74		
	TAIL 1	1281.7	16.45	.18	3.31			6.91	4.13		
	TAIL 2	1330.9	17.08	.22	2.55			8.77	3.31		
	TAIL 3	1478.1	18.97	.22	3.08	3.62	46.4	9.74	4.44		
	TAIL 4	1370.9	17.60	.23	3.13			9.44	4.18		
	HEAD	7791.3	100.00	.43	13.17			100	100		

POINT LEAMINGTON DEPOSIT CYCLE TEST 39 PREDICTED RESULTS CYCLES 3+4

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	16.1	.82	18.5	7.5	48.3	173	36.50	.47	10.73	2.97
	ZN CL CONC	290	14.75	.3	57.1	1.46	41.2	10.66	64.47	5.84	12.73
	ZN CL SCAV TAIL	235.4	11.97	.5	19.5	3.78	55.2	14.43	17.87	12.28	13.85
	ZN SCAV TAIL	1424.5	72.46	.22	3.1	3.62	46.4	38.41	17.19	71.15	70.45
	OVERALL TAIL		84.43	.26	5.43	3.64	47.65	52.83	35.06	83.43	84.30
	HEAD	1966	100.00	.42	13.07	3.69	47.72	100	100	100	100

LOCKED CYCLE TEST 40 - 43

HIGH ZN COMPOSITE (VARY GRIND)



TEST	% - 400 mesh
40	
41	81.0
42	59.1
43	98.5

POINT LEAMINGTON DEPOSIT TEST NUMBER 40

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC 1	19.7	.25	16.8	7.5			9.46	.16		
	CU CL CONC 2	40.3	.51	10.9	8.5			12.55	.36		
	CU CL CONC 3	30.4	.38	13.4	8.6			11.64	.27		
	CU CL CONC 4	38.4	.49	11.1	7.5			12.18	.30		
	CU SCAV CONC 4	14.7	.19	2.08	9.8			.87	.15		
	CU 3 CL TAIL 4	16.4	.21	1.69	9.5			.79	.16		
	CU 2 CL TAIL 4	43.5	.55	1.17	9.8			1.45	.45		
	CU CL SC TL 4	150.7	1.91	.54	11.3			2.32	1.79		
		0	.00	0	0						
	ZN CL CONC 1	139.1	1.76	.19	54.9			.76	8.01		
	ZN CL CONC 2	265.6	3.36	.23	54.8			1.75	15.27		
	ZN CL CONC 3	196.8	2.49	.21	55.5			1.18	11.46		
	ZN CL CONC 4	247.1	3.13	.22	53.8			1.55	13.95		
	ZN SCAV CONC 4	42.9	.54	.35	37			.43	1.67		
	ZN 3 CL TAIL4	44.3	.56	.39	39			.49	1.81		
	ZN 2 CL TAIL 4	101.8	1.29	.36	22.7			1.05	2.43		
	ZN CL SC TL 1	195.1	2.47	.19	15.4			1.06	3.15		
	ZN CL SC TL 2	252.9	3.20	.26	15.8			1.88	4.19		
	ZN CL SC TL 3	293.5	3.71	.28	19.4			2.35	5.98		
	ZN CL SC TL 4	266.1	3.37	.31	16.6			2.36	4.64		
	TAIL 1	1212.5	15.35	.2	2.7			6.93	3.44		
	TAIL 2	1347	17.05	.22	3.8			8.47	5.37		
	TAIL 3	1485.5	18.80	.22	5.2			9.34	8.11		
	TAIL 4	1456.8	18.44	.22	4.5			9.16	6.88		
	HEAD	7901.1	100.00	.44	12.06			100	100		

POINT LEAMINGTON DEPOSIT CYCLE TEST 40 PREDICTED RESULTS CYCLES 3+4

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	34.4	1.71	12.1	8	33.6	108.8	47.85	1.12	14.86	3.82
	ZN CL CONC	222	11.06	.22	54.6	1.23	49.2	5.61	49.19	3.51	11.14
	ZN CL SCAV TAIL	279.8	13.94	.29	18	3.61	45.2	9.33	20.44	12.98	12.89
	ZN SCAV TAIL	1471.2	73.29	.22	4.9	3.63	48.1	37.21	29.25	68.65	72.15
	OVERALL TAIL		87.23	.23	6.99	3.63	47.64	46.54	49.69	81.63	85.05
	HEAD	2007.4	100.00	.43	12.28	3.88	48.86	100	100	100	100

POINT LEAMINGTON DEPOSIT TEST NUMBER 41

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC 1	9.5	.12	26.6	4.5			7.46	.05		
	CU CL CONC 2	55.8	.71	9.02	7.5			14.86	.44		
	CU CL CONC 3	32	.41	12.5	7.8			11.81	.26		
	CU CL CONC 4	47	.60	8.59	8			11.92	.40		
	CU SCAV CONC 4	14.2	.18	2.3	8			.96	.12		
	CU 3 CL TAIL 4	17	.22	1.54	7.9			.77	.14		
	CU 2 CL TAIL 4	38	.49	1.14	7.9			1.28	.32		
	CU CL SC TL 4	119.9	1.54	.65	10			2.30	1.26		
		0	.00	0	0						
	ZN CL CONC 1	133.6	1.71	.17	56.3			.67	7.93		
	ZN CL CONC 2	260.2	3.33	.2	55.3			1.54	15.17		
	ZN CL CONC 3	267.9	3.43	.22	56.5			1.74	15.96		
	ZN CL CONC 4	291.1	3.73	.21	58			1.81	17.80		
	ZN SCAV CONC 4	35	.45	.39	41			.40	1.51		
	ZN 3 CL TAIL4	35	.45	.47	45			.49	1.66		
	ZN 2 CL TAIL 4	74.2	.95	.44	31.5			.96	2.46		
	ZN CL SC TL 1	219.3	2.81	.29	18			1.88	4.16		
	ZN CL SC TL 2	228.7	2.93	.3	17.9			2.03	4.32		
	ZN CL SC TL 3	251.6	3.22	.32	16.7			2.38	4.43		
	ZN CL SC TL 4	269.7	3.45	.3	16.2			2.39	4.61		
	TAIL 1	1317.5	16.88	.2	3.05			7.78	4.24		
	TAIL 2	1352.4	17.32	.2	3.06			7.99	4.36		
	TAIL 3	1375.5	17.62	.21	2.93			8.53	4.25		
	TAIL 4	1361.1	17.44	.2	2.88			8.04	4.13		
	HEAD	7806.2	100.00	.43	12.15			100	100		

POINT LEAMINGTON DEPOSIT CYCLE TEST 41 PREDICTED RESULTS CYCLES 3+4

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	39.6	2.03	10.2	7.9	27.7	136	48.62	1.27	14.69	5.86
	ZN CL CONC	279.5	14.35	.21	57.3	1.27	38.5	7.07	65.18	4.75	11.72
	ZN CL SCAV TAIL	260.7	13.38	.31	16.4	3.4	47.9	9.73	17.40	11.87	13.60
	ZN SCAV TAIL	1368.3	70.24	.21	2.9	3.75	46.2	34.59	16.15	68.70	68.83
	OVERALL TAIL		83.62	.23	5.06	3.69	46.47	44.32	33.55	80.56	82.42
	HEAD	1948.1	100.00	.43	12.61	3.83	47.15	100	100	100	100

POINT LEAMINGTON DEPOSIT TEST NUMBER 42

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC 1	31.2	.39	12.6	10.5			10.78	.34		
	CU CL CONC 2	42.8	.54	8.73	10.2			10.25	.45		
	CU CL CONC 3	64.8	.81	5.99	9.8			10.65	.66		
	CU CL CONC 4	23.4	.29	14.6	11.1			9.37	.27		
	CU SCAV CONC 4	7.2	.09	3.26	11.5			.64	.09		
	CU 3 CL TAIL 4	11.6	.15	1.92	11			.61	.13		
	CU 2 CL TAIL 4	36.2	.45	1.23	11.5			1.22	.43		
	CU CL SC TL 4	124.7	1.56	.65	13.2			2.22	1.71		
		0	.00	0	0						
	ZN CL CONC 1	231.7	2.90	.22	52.8			1.40	12.73		
	ZN CL CONC 2	194.9	2.44	.24	53.9			1.28	10.93		
	ZN CL CONC 3	170.8	2.14	.25	54.4			1.17	9.67		
	ZN CL CONC 4	204.4	2.56	.26	54.2			1.46	11.53		
	ZN SCAV CONC 4	19.6	.25	.45	39.4			.24	.80		
	ZN 3 CL TAIL4	12	.15	.49	38.9			.16	.49		
	ZN 2 CL TAIL 4	36.2	.45	.42	18.2			.42	.69		
	ZN CL SC TL 1	157.3	1.97	.25	13.6			1.08	2.23		
	ZN CL SC TL 2	174.5	2.18	.29	17.6			1.39	3.20		
	ZN CL SC TL 3	169.9	2.13	.27	19.7			1.26	3.48		
	ZN CL SC TL 4	165.4	2.07	.29	18.3			1.32	3.15		
	TAIL 1	1313.1	16.42	.22	3.3			7.92	4.51		
	TAIL 2	1557.6	19.48	.26	6.43			11.11	10.42		
	TAIL 3	1569.8	19.64	.26	6.75			11.19	11.03		
	TAIL 4	1675.6	20.96	.28	6.34			12.87	11.06		
	HEAD	7994.7	100.00	.46	12.02			100	100		

OINT LEAMINGTON DEPOSIT CYCLE TEST 42 PREDICTED RESULTS CYCLES 3+4

OMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
IGH ZN	CU CL CONC	44.1	2.18	8.3	10.1	20.9	93	40.67	1.83	11.95	4.24
	ZN CL CONC	187.6	9.28	.26	54.3	1.36	37.8	5.42	41.84	3.31	7.34
	ZN CL SCAV TAIL	167.7	8.29	.28	18.9	3.45	44.3	5.22	13.02	7.50	7.68
	ZN SCAV TAIL	1622.7	80.25	.27	6.5	3.67	48.1	48.69	43.32	77.23	80.74
	OVERALL TAIL		88.54	.27	7.66	3.65	47.74	53.90	56.33	84.74	88.42
	HEAD	2022.1	100.00	.45	12.04	3.81	47.81	100	100	100	100

OINT LEAMINGTON DEPOSIT TEST NUMBER 43

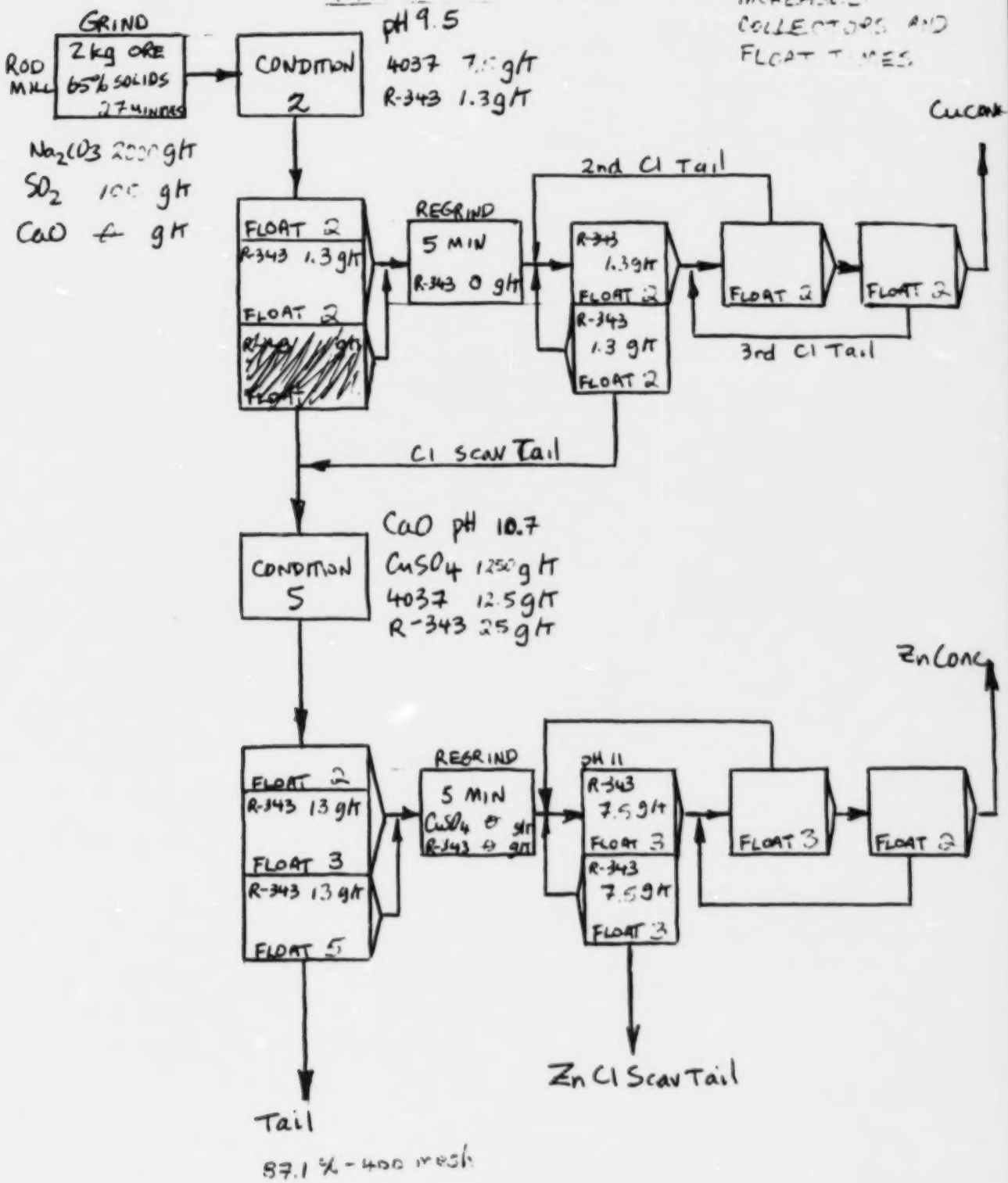
COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC 1	14.2	.18	21.7	6.4			8.47	.09		
	CU CL CONC 2	20.4	.26	22	6.2			12.33	.12		
	CU CL CONC 3	23.8	.30	21.2	6.73			13.86	.16		
	CU CL CONC 4	19.2	.24	22.2	6.2			11.71	.12		
	CU SCAV CONC 4	6.1	.08	8.75	7.88			1.47	.05		
	CU 3 CL TAIL 4	5.7	.07	6.84	9.05			1.07	.05		
	CU 2 CL TAIL 4	18	.23	4.11	8.86			2.03	.16		
	CU CL SC TL 4	104.5	1.31	1.82	8.79			5.23	.90		
		0	.00	0	0						
	ZN CL CONC 1	146.4	1.83	.15	56.6			.60	8.16		
	ZN CL CONC 2	140.4	1.76	.16	56.6			.62	7.83		
	ZN CL CONC 3	156.6	1.96	.17	56.4			.73	8.70		
	ZN CL CONC 4	174.6	2.19	.26	56.2			1.25	9.66		
	ZN SCAV CONC 4	59.5	.74	.46	49			.75	2.87		
	ZN 3 CL TAIL4	61.8	.77	.4	55.5			.68	3.38		
	ZN 2 CL TAIL 4	125.2	1.57	.43	48.5			1.48	5.98		
	ZN CL SC TL 1	203.1	2.54	.24	18			1.34	3.60		
	ZN CL SC TL 2	243.1	3.04	.29	24.4			1.94	5.84		
	ZN CL SC TL 3	273	3.42	.29	24.5			2.18	6.59		
	ZN CL SC TL 4	254	3.18	.44	22.3			3.07	5.58		
	TAIL 1	1303.3	16.32	.15	2.77			5.37	3.56		
	TAIL 2	1539.3	19.27	.17	5.71			7.19	8.66		
	TAIL 3	1484.2	18.58	.18	5.42			7.34	7.92		
	TAIL 4	1610.3	20.16	.21	6.32			9.29	10.02		
	HEAD	7986.7	100.00	.46	12.71			100	100		

POINT LEAMINGTON DEPOSIT CYCLE TEST 43 PREDICTED RESULTS CYCLES 3+4

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	21.5	1.08	21.7	6.5			51.27	.56		
	ZN CL CONC	165.6	8.29	.22	56.3			4.00	37.62		
	ZN CL SCAV TAIL	263.5	13.19	.37	23.5			10.71	24.98		
	ZN SCAV TAIL	1547.3	77.45	.2	5.9			34.01	36.83		
	OVERALL TAIL		90.64	.22	8.46			44.72	61.82		
	HEAD	1997.9	100.00	.46	12.41			100	100		

LOCKED CYCLE TEST 44

NOVEMBER 87



POINT LEAMINGTON DEPOSIT TEST NUMBER 44

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH Zn LOW	CU CL CONC 1	28.2	.36	13.2	6.74			10.05	.20		
	CU CL CONC 2	49.4	.62	11.1	7.34			14.81	.38		
	CU CL CONC 3	44.1	.56	13.2	7.65			15.72	.35		
	CU CL CONC 4	50.1	.63	9.6	8.14			12.99	.42		
	CU SCAV CONC 4	26.9	.34	2.21	8.4			1.61	.23		
	CU 3 CL TAIL 4	27.5	.35	2.49	8.81			1.85	.25		
	CU 2 CL TAIL 4	42.1	.53	1.18	8.56			1.34	.37		
	CU CL SC TL 4	148.2	1.87	.62	9.1			2.48	1.40		
		0	.00	0	0						
	ZN CL CONC 1	307.5	3.89	.22	51.9			1.83	16.51		
	ZN CL CONC 2	330.8	4.18	.26	51.7			2.32	17.69		
	ZN CL CONC 3	320.1	4.05	.23	53.4			1.99	17.68		
	ZN CL CONC 4	328.6	4.16	.21	54.4			1.86	18.49		
	ZN SCAV CONC 4	54.5	.69	.35	49.4			.52	2.79		
	ZN 3 CL TAIL4	73.4	.93	.45	42.2			.89	3.20		
	ZN 2 CL TAIL 4	64.5	.82	.42	46.3			.73	3.09		
	ZN CL SC TL 1	153.2	1.94	.26	3.61			1.08	.57		
	ZN CL SC TL 2	173.9	2.20	.41	9.11			1.93	1.64		
	ZN CL SC TL 3	148.2	1.87	.44	17.6			1.76	2.70		
	ZN CL SC TL 4	162.1	2.05	.46	18.9			2.01	3.17		
	TAIL 1	1105.2	13.98	.14	.96			4.18	1.10		
	TAIL 2	1367	17.29	.16	1.26			5.91	1.78		
	TAIL 3	1456.3	18.42	.16	2.07			6.29	3.12		
	TAIL 4	1446.2	18.29	.15	1.92			5.86	2.87		
	HEAD	7908	100.00	.47	12.22			100	100		

POINT LEAMINGTON DEPOSIT CYCLE TEST 44 PREDICTED RESULTS CYCLES 3+4

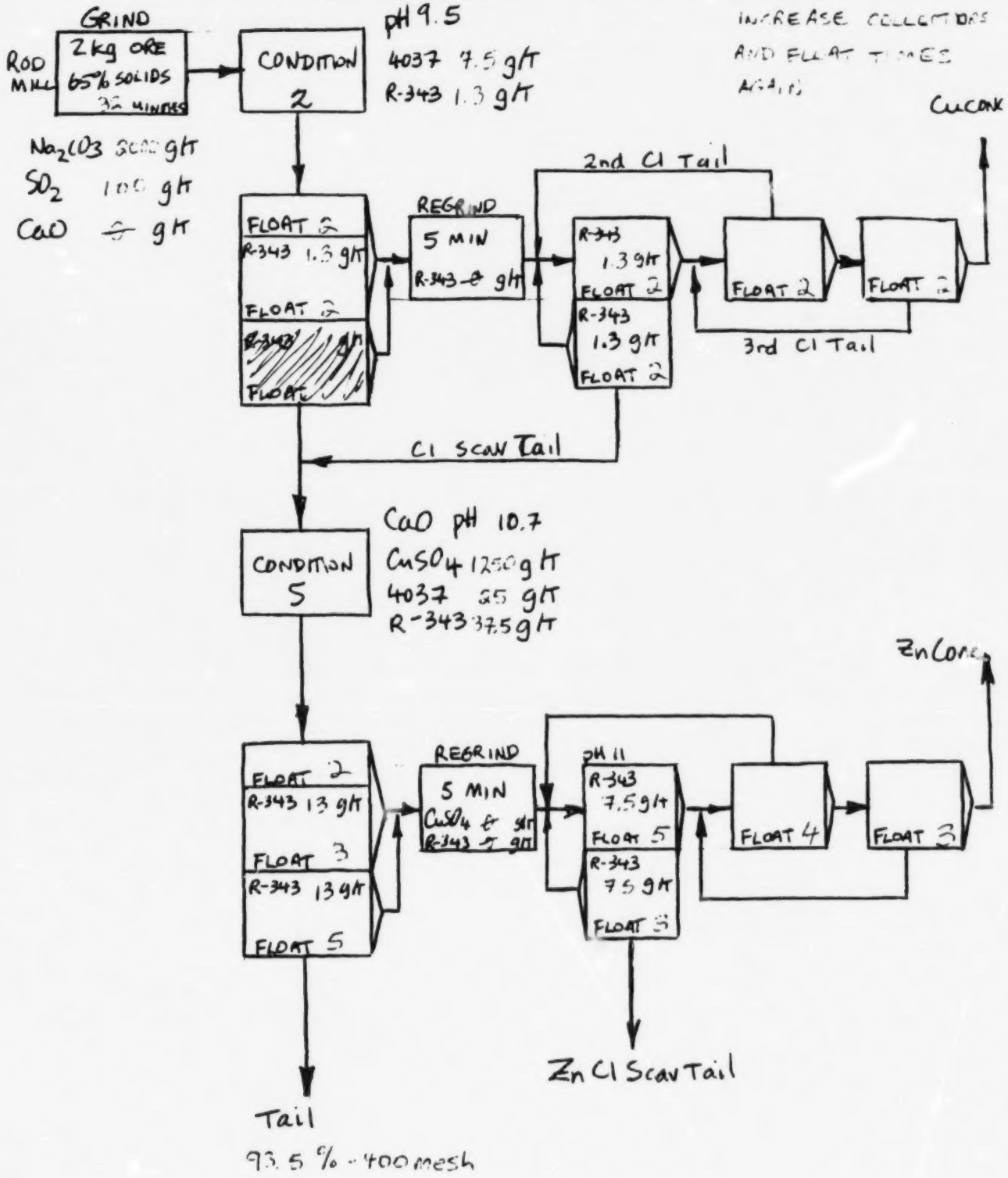
COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	47.1	2.38	11.3	7.9			58.70	1.56		
	ZN CL CONC	329.4	16.61	.22	53.9			7.99	74.38		
	ZN CL SCAV TAIL	155.2	7.83	.45	18.3			7.70	11.90		
	ZN SCAV TAIL	1451.3	73.19	.16	2			25.61	12.16		
	OVERALL TAIL		81.01	.19	3.57			33.31	24.06		
	HEAD	1983	100.00	.46	12.04			100	100		

LOCKED CYCLE TEST 45

DECEMBER 19[illegible]

HIGH Zn COMPOSITE

PULL Zn HARDEN. INCREASE COLLECTORS AND FLOAT TIMES AGAIN



POINT LEAMINGTON DEPOSIT TEST NUMBER 45

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
High Zn [redacted]	CU CL CONC 1	45.9	.57	12.4	8.08			15.38	.36		
	CU CL CONC 2	62.2	.77	9.3	8.67			15.63	.52		
	CU CL CONC 3	55.8	.69	9.55	8.62			14.40	.47		
	CU CL CONC 4	66.2	.82	7.75	8.33			13.86	.53		
	CU SCAV CONC 4	21.2	.26	1.21	8.69			.69	.18		
	CU 3 CL TAIL 4	25.5	.32	1.12	8.6			.77	.21		
	CU 2 CL TAIL 4	58.9	.73	.88	8.23			1.40	.47		
	CU CL SC TL 4	142	1.77	.41	9.71			1.57	1.34		
		0	.00	0	0						
	ZN CL CONC 1	327.8	4.08	.24	55.2			2.13	17.54		
	ZN CL CONC 2	346.9	4.31	.23	55.7			2.16	18.73		
	ZN CL CONC 3	372.1	4.63	.24	55.5			2.41	20.02		
	ZN CL CONC 4	366.9	4.56	.24	54			2.38	19.21		
	ZN SCAV CONC 4	64	.80	.31	42.6			.54	2.64		
	ZN 3 CL TAIL4	44.9	.56	.38	41.3			.46	1.80		
	ZN 2 CL TAIL 4	81.1	1.01	.42	35.2			.92	2.77		
	ZN CL SC TL 1	122.2	1.52	.36	6.19			1.19	.73		
	ZN CL SC TL 2	163.9	2.04	.38	18.5			1.68	2.94		
	ZN CL SC TL 3	143.2	1.78	.36	8.86			1.39	1.23		
	ZN CL SC TL 4	156.3	1.94	.34	12			1.44	1.82		
	TAIL 1	1313.1	16.33	.15	1.38			5.32	1.76		
	TAIL 2	1346.5	16.74	.13	1.45			4.73	1.89		
	TAIL 3	1340.9	16.67	.13	.91			4.71	1.18		
	TAIL 4	1375.9	17.11	.13	1.24			4.83	1.65		
	HEAD	8043.4	100.00	.46	12.82			100	100		

POINT LEAMINGTON DEPOSIT CYCLE TEST 45 PREDICTED RESULTS CYCLES 3+4

COMPOSITE	PRODUCT	WEIGHT		ASSAYS % OR G/T				% DISTRIBUTION			
		gms	%	CU	ZN	AU	AG	CU	ZN	AU	AG
HIGH ZN	CU CL CONC	61	3.15	8.6	8.4			62.28	2.15		
	ZN CL CONC	369.5	19.06	.24	54.8			10.53	85.03		
	ZN CL SCAV TAIL	149.8	7.73	.35	10.4			6.22	6.54		
	ZN SCAV TAIL	1358.4	70.07	.13	1.1			20.97	6.27		
	OVERALL TAIL		77.79	.15	2.02			27.19	12.82		
	HEAD	1938.7	100.00	.43	12.28			100	100		